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LIST OF FOREIGN AGENTS (see first page "Official Notices").

Contents:

	PAGE
Increased Production	721
Rural Electrification	722
The Tramway Tribunal's Report	722
Electricity and Gas at Leicester	723
Tidal Power	723
The E.T.B.I.	723
The French Electro-farming Congress and Exhibition, by R. Borlase Matthews (*illus.*) (*concluded*)	724
Tidal Power Installations, by A. J. V. Underwood (*illus.*)	725
Increased Production—Decreased Unemployment (*illus.*)	727
Smoke Abatement (*illus.*)	729
Correspondence—	
A Modern Electric Flat	730
Wiring by Direct Labour	730
Wiring Regulations	731
Making Hay Without Sunshine	731
Our Debt of Honour	732
Electrical Heating	732
Radio-transformer Characteristics	732
The Improvement of Power Factor	732
Reviews	733
Business Notes	734
Lighting and Power Notes	737
Electricity Supply in Cape Town (*illus.*)	739
Electricity Supply at St. Pancras, London (*illus.*)	741
Tramway and Railway Notes	743
Telegraph and Telephone Notes	743
Radio Notes	744
Contracts Open and Closed	744
Forthcoming Events	745
Notes	746
Institution Notes	747
Our Personal Column	747
New Companies Registered	748
Official Returns of Electrical Companies	748
City Notes	748
Stocks and Shares	749
Market Quotations for Chemicals and Metals	750
An Investigation of the Grid Leak Circuit, by N. Wells (*illus.*)	751
Japanese Commerce and Industry	752
The Electrical Exports of the United States	753
An Electric Harmonic Analyser, by J. D. Cockcroft, R. T. Coe, J. T. Tyacke, and Prof. Miles Walker (*illus.*)	754
Tramway Employes' Wages	755
Larner-Johnson Hydraulic Valves (*illus.*)	756
Electricity Supply	757
New Electrical Devices, Fittings, and Plant (*illus.*)	758
Legal	759
Published Specifications	760
Contractors' Column	Advertisement page xxxvi

Increased Production.

MANY bitter feelings have been engendered and many scathing and unconstructive criticisms have been levelled at various sections of society in consequence of the appalling state of unemployment during the last few years in this country. With this atmosphere prevailing, it has been impossible for those who give earnest thought to the possible solutions of the problems involved to get their proposed remedies applied in practice.

Our first suggestion, therefore, as mentioned in our leader on "The Waste of Capitalism" in our issue of October 24th, is that all sides should accept their share of the responsibility and co-operate in an honest endeavour to find a joint solution of the problems connected with the restoration of the industrial welfare of this country.

With this object in view, we venture in later pages of this issue to put before all classes of our readers the views of a special contributor on some of the problems in the hope that each will take his or her share, however small, in assisting in proposals for reviving industry. It will be an incentive to them to do their best to remember that by bringing about such a revival they will be helping in the best possible way their fellow men who are unemployed (whose families, in consequence, are in most cases living on a mere subsistence), thus brightening their lot and quenching the bitter criticism referred to above.

Anybody associated with the British workpeople realises that they are often suspicious, due to the lack of full knowledge of business organisation, and that their insecurities of life intensify their expressions of feeling, but on the other hand, the great majority are good and loyal at heart, and if some measure of security is in front of them, they are the very last people to bother seriously about questions of management or the fact that they are working under a capitalist system, nor would they wish to press that great step in the dark—nationalisation of industry. Insecurity of employment and living is the real anxiety and the foundation of most of their claims, and if this can be removed their views may bear a very different aspect.

Our intention in publishing the article which is com-

menced in this issue is to deal with questions of organisation within separate factories, but if we were to fail to include any reference to some of the questions at the root of industry, it would be like unto a gardener building a pergola over which to train a beautiful rambler rose without first providing the right sort of soil from which the runners could gain their strength and growth.

The terms of reference of this problem appear simple, namely, the production of the best article in the shortest time; but one has to travel far before a solution is reached, and when one fully realises the immensity of this problem one is apt to feel how very little can be accomplished by individuals in the speeding-up of the flywheel of industry with its immense inertia—but this flywheel can and must be speeded up.

The writer suggests that the first thing to be appreciated is the meaning of minimum cost. It must be realised that it is the most elusive thing that can be conceived. Our solar system works on a definite periodic basis—not so with minimum cost. Our engineers are able to take raw materials and, after proper tests and inspection, have a constant basis for their calculations as to stresses, induction, electrical losses, &c. There are no such constants with real minimum cost, as many of the factors concerned are irregular variables.

In the report referred to in our leading article of October 24th, by a Committee of the Trade Union Congress, &c., set up to inquire into the causes of low production in industry, their idea of maximum production is "that which is reached when prices cover the minimum cost of production by the most economical methods consistent with the maintenance of a proper and progressive standard of life for the producers."

Let us apply this to an electrical article to find its minimum cost. First, the so-called raw material used by the electrical manufacturer must be produced and supplied at a minimum cost by the manufacturer of that raw material, and the latter must obtain his raw material at minimum cost, and so on, until we get back to coal, iron ore, copper ore, &c. Thus, the first step in producing an electrical article at minimum cost is the production of cheap coal and cheap power, especially when one remembers that modern practice takes approximately 1¾ tons of coal to produce a ton of pig iron, another half-ton of coal to produce a ton of steel billets, and a further half to three-quarters of a ton of coal for a ton of forgings, *i.e.*, a total of about three tons of coal to produce one ton of forgings. It must also be realised, as is explained in the article, that the cost of an article is an inverse function of the output. The conclusion to be drawn is that the first essentials in the revival of industry are cheap coal and iron.

In considering this problem it must be realised that men, for psychological reasons, although admittedly wrong, do not give their maximum effort under present conditions, as by so doing they feel they are only using up quicker the small amount of work that is available. Thus we cannot begin to approach the question of minimum cost of coal and iron until our coal mines and steel works see prospects of regular employment. We therefore suggest that the first great step can come from the Government—not by subsidising industry as was suggested a little time ago by the chairman of one of the big steel combines, but by utilising the full possibilities of extension of the Trade Facilities Act, by providing funds to enable coal mines to produce a regular output (for stock), and the steel works to produce a regular output (again for stock) at the right price. We recommend that the Balfour Committee give earnest consideration to proposals on these lines.

We feel that the impulse for a revival must come as a result of bold action on the part of the executives and workers in industry. Mere condemnation, be it from either side, will not produce a revival. One side cannot exist without the other. This is clearly indicated in the case of Russia, which finds it compulsory to seek from capitalist peoples the funds with which to give an impetus to the revival of its own industries.

A courageous manufacturing policy, with the right sort of financial backing, such as can be given by the Government under extended trade facilities arrangements, and the loyal co-operation of labour, are the first essentials to give further impulse to the flywheel of industry.

Rural Electrification.

The statistics given on another page by Mr. R. Borlase Matthews, with regard to the rate at which the use of electricity is advancing in the rural areas of France, are worthy of the close attention of all who are interested either in social economics or in the electrical industries. One of the strongest arguments for the extension of electricity supply into the country is that it will help to retain the population on the land. That object cannot be realised unless the supply is utilised when it is made available. It is important for us to know, therefore, that the experience gained by our neighbours in this respect since the war has been satisfactory in the highest degree: the consumption of electrical energy during the past five years in rural districts has bounded upwards, and is now in some cases ten times its original value. Such a statement would carry no weight if the consumption in 1918 were of trifling amount, but as Mr. Matthews shows, in one instance, an annual output of 30 million kWh has increased to 300 millions. These are very significant figures, and offer good prospect of further increase, for it is obvious that the greater the consumption of energy the more cheaply can it be supplied, and, therefore, the greater will be the demand. And when the existing population has thus made a cheap supply possible, the establishment of village industries requiring small power may confidently be expected to follow, with the result that the rural population will tend to increase. The development of the domestic uses of electricity, abolishing the noisome oil lamp and otherwise improving the conditions of living in the country, will add other factors to the argument in favour of rural electrification, which could be elaborated if it were necessary.

As for the bearing of the matter on the electrical industries, we need do no more than point to the enormous market for all kinds of manufactured products, from the big power plant down to the electric fan, that would be thrown open by rural electrification. Even more than in the towns, the domestic uses of electricity would be appreciated and welcomed, and the advantage of having available a supply of power, readily developed at any point on a farm, practically free from fire risk, requiring no fuel or water, and involving no waste when not in use or when used intermittently, could not fail to gain recognition.

All this is not speculation; it is taking place before our eyes, across the Channel, at this moment. Are we to lag behind? Shall we be daunted by needlessly stringent regulations, whether for overhead wires or for indoor wiring? Shall we let the wayleave problem block the way? Or shall we resolve to suffer no obstacle to hinder our progress, but to act with courage and foresight, and to carry the blessings of electricity supply to those who need it so urgently? Those startling figures should awaken our supply authorities to the field that is open to them, and to the duty which rests upon their shoulders.

The Tramway Tribunal's Report.

Elsewhere in this issue we review the report of the Special Tribunal set up by the National Joint Industrial Council for the Tramway Industry to consider demands for increased wages and improved conditions put forward by the employés of that industry.

As was to be expected, the decisions take the form of a number of compromises which, upon the whole, are favourable to the employés, while not imposing many extra burdens upon an industry which is already loaded to the limit—or, in some individual cases, beyond the limit.

The employés asked for standardisation; an attempt to effect this, although not upon the lines suggested, has been made. The employés' proposals were for the formation of four groups, the determination of standard rates of wages for the various occupations in each group, and an increase of 10 per cent. upon wages so standardised; in addition, a minimum of 52s. per 48-hour week for all workers was proposed. The Tribunal has found it necessary to form six groups, and it was unable to classify a number of undertakings. As regards the increase applied for, the Tribunal has endeavoured to satisfy both parties, first, by assuring the employés that in no case will any reductions be made; and, secondly, by limiting increases to 1s. 6d. per week.

In the place of the 25 per cent. addition to the day rates which the employés thought should be conceded to night workers, the Tribunal recommends an extra 6s. per week for London and 4s. per week outside.

So far as stabilisation is concerned, the Tribunal suggests that the amended rates should remain in force until the end of 1925, when they will be terminable at three months' notice by either side.

In the absence of the vast amount of statistics with which the Tribunal must have had to deal we are unable to gauge the effects of the decisions and, therefore, their chances of acceptance by the National Council.

Electricity and Gas at Leicester.

A REPORT recently submitted to the Leicester City Council by a special Committee, which was appointed to consider the whole question of the production and distribution of light, heat, and power by the Electricity and Gas Committees, with special regard to the subject of competition, is of some interest in view of the local conditions.

The Corporation commenced the supply of electricity in 1894. The undertaking was one of the few that were initiated under the direction of a gas committee, the station being erected at the gas works. Since that date large extensions have been carried out, the most recent of which were described in our issue of December 29th, 1922.

In the meantime the Tramways Committee had erected a d.c. station in 1904 to supply power to the tramways, and in 1911 the whole of the supply of electricity for all purposes was entrusted to Mr. T. R. Smith, M.I.E.E. A separate Electricity Committee was appointed in 1921, and under Mr. Smith's *régime*, with the aid of Mr. C. H. Wordingham, a new power station was set in operation at the end of 1922, when it was stated that the domestic load might become as great as the power load, and the Committee received the strong approval of the Corporation for a scheme of development.

Now comes this report, which appears to indicate that the gas undertaking is feeling the draught from the progressive policy of the Electricity Department. It begins by reducing both gas and electricity to a "common denominator, *viz.*—British thermal units," and finds that the gas consumer receives far more of these for a penny than the electricity consumer, but admits that the higher efficiency of electrical apparatus considerably reduces this advantage. On the score of conserving the national fuel resources, the palm is handed to gas with a thermal efficiency claimed to be 84 per cent., of which figure 50 represents coke and 11 tar, as compared with 8½ per cent. for electricity last year, when the out-of-date plant was in operation. It is conceded that the new central station burns fuel of lower grade and gives an efficiency of 14.2 per cent. Since the B.Th.u. contained in coke and gas cannot be utilised without heavy loss, and those contained in tar are not usually released as heat at all, the 84 per cent. is obviously and literally a gross exaggeration, whereas the 14.2 per cent. for electricity represents "strictly net" energy which can be fully utilised. Both gas and electricity are given credit for effective smoke abatement. For light, heat, and power, the conclusion is drawn that gas is cheaper but electricity is cleaner and more convenient, and credit is given to the latter for economies resulting from its flexibility in application. With regard to cooking, competitive tests were carried out, a dinner for five persons being cooked at a cost of less than ½d. per person in each case; the electric oven appeared to be the more efficient, but the top of the gas stove the more serviceable. Shrinkage of food cooked by electricity was considerably less than by gas. Water was more cheaply heated by gas.

On the whole, the committee recommends gas for cooking and electricity for lighting in the home, but recognises that whilst electrical appliances are expensive, they offer the housewife "an easy escape from domestic drudgery." At present it "cannot see that limitation of either of the two services is practicable or desirable. The keen rivalry between them serves to stimulate both with a consequent benefit to the consumers." We cordially agree with this verdict, and would compliment the Committee on the desire to be fair to both services which marks the report. It may be inferred that the rapid and continuing development of the electricity undertaking under the vigorous policy of Mr. T. R. Smith, city electrical engineer, which was made possible by its transfer to a separate committee, has alarmed the supporters of gas, and that an attempt has been made to put the brake on the progress of its foster-child. The report does not do justice to the merits of electricity in comparison with gas, but it certainly discharges the aggressive youngster without a stain on its character—a notable decision in such a gassy atmosphere—and accords it a fair field and no favour. That is all that electricity need ask for; and more than it receives in some other cities where both gas and electricity are in municipal hands, and the degree of competition between them, unfortunately, is artificially and arbitrarily restricted. Such a limitation is contrary to the public interest, and cuts at the root of progress and enterprise.

Tidal Power.

THE article on "Tidal Power Installations" which appears on another page deals with an aspect of the problem of which little has been said in this country. At first sight the proposal to use compressed air as a link in the conversion of tidal power into electric power seems an unnecessary complication; but the importance of the subject justifies us in considering every possible method of dealing with it, and the fact that this system has been for some years in operation on a fairly large scale abroad is evidence of its practicability. It is true that the existing installations are actuated by river water, but that is no argument against the suitability of the system for tidal operation—on the contrary, the fact that it finds useful application on rivers in competition with turbines is a point in its favour.

The E.T.B.I.

AGAIN we would briefly plead the cause of the Electrical Trades Benevolent Institution, of which the annual festival takes place next Wednesday. There is still time to obtain tickets, and it is never too late to contribute to the funds. The cost of administering the funds is extraordinarily modest, and the money is expended with the greatest circumspection, but not, we are glad to say, in a niggardly fashion. Many a man has secured a fresh start as a self-supporting citizen through the timely aid of the E.T.B.I.—and that with the most rigorous secrecy. All those who are employed in the electrical industry and have no other benevolent funds to rely upon are eligible for help, and in particular it is desirable that they should become actual "members" of the Institution, the cost of which is trifling whilst the advantages are many. Further, the kindly support of employers, which can be given and made effective without any outlay, is invited; if they would post notices in their offices and warehouses, drawing attention to the Institution and its objects, the membership would be increased, and in other ways—for instance, by calling an annual meeting of employés, by encouraging members of their staffs to become collectors, and so on—they can afford invaluable assistance at a minimum expense of time and trouble.

The French Electro-Farming Congress and Exhibition.

By R. BORLASE MATTHEWS, Wh.Ex., A.M.Inst.C.E., M.I.E.E., F.R.Ae.S.

(*Concluded from p. 687.*)

PERHAPS one of the most striking of the exhibits at Lyons, to the English eye, was a series of diagrams which demonstrated the wonderful progress that has been made by French electricity supply undertakings in rural areas. During the past five years these undertakings have increased their total annual output from three to ten times—in one case, that of the rural district around

Fig. 1.—The Devilaine and Rouge 50-kVA Rural Outdoor Transformer Station.

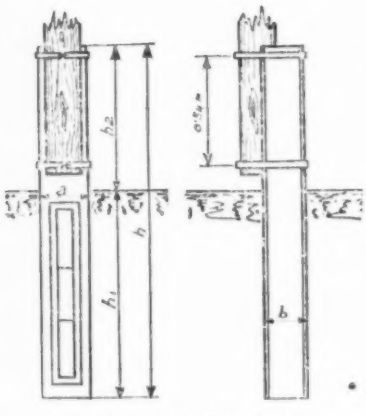


Fig. 2.—The Palix Wood-pole Ferro-concrete Support.

Paris, the increase was thirteen times. However, in all probability a good portion of the increase in this case was due to suburban building.

The statistics were shown by means of maps and various ingenious diagrams. The maps of the present existing networks were a wonderful sight, especially when compared with maps of the same areas in 1918. All over France the power load has risen from a negligible amount to more than equal to the lighting load. French manufacturers of insulators and pole-line material generally must have had a very busy time.

The following table is given to illustrate a typical case of post-war rural electrical expansion :—

THE EFFECT OF RURAL ELECTRIFICATION.

Data concerning the Lorraine Electricity Supply Undertaking (Nancy, France).

Year	1918.	1923.
Kilowatt-hours sold	30,000,000	300,000,000
Villages and hamlets supplied ...	95	992
Lamps connected	65,000	302,000
Motors connected	666	4,423
Transformers	2,300	12,000
High-pressure lines: kilometres ...	219	1,620
Ditto, miles	136	650
Low-pressure lines: kilometres ...	404	2,837
Ditto, miles	252	1,780

Such results indicate that the French policy of rural electrification is a sound one; for if the construction of a network over the countryside means an increase of ten times in the energy sold, the cost of this network becomes a very important problem. If the constructional cost is low enough, and if the price of energy is acceptable, it makes the supply of electricity very remunerative. Since the lines are financed by the State on easy terms, the lot of the French central stations is a very profitable one—in fact, so much so that an outcry is beginning to arise. However, they are protecting themselves, as is the case with most public utility undertakings, by concealing their profits in the strengthening of their financial position.

In the course of these notes last week, reference was made to a type of constructional steel transformer tower that is being developed in France. An illustration, fig. 1, is given herewith of one of these towers of the Devilaine and Rougé type. This, in several features, is in advance of the designs generally adopted. In particular, ample ventilation is provided for the transformer. Again, the transformer is supported above the ground level at cart height. This greatly facilitates the placing in position or the removal of a transformer at any time.

Fig. 2 shows a typical ferro-concrete wood-pole support of the Palix type. It will be observed that holes are not required to be drilled through the pole. A step is provided to take the weight of the pole. The dimension h averages 7 ft. 6 in., the length of h_1 is 4 ft. 6 in., and that of h_2 is 3 ft. The dimensions a and b vary with the horizontal transverse load (between 100 and 200 pounds) from 1 ft. by 6¼ in. to 1 ft. 3 in. by 1 ft., for poles from 6 to 10 in. in diameter. The distance apart of the straps is about 20 in. In fig. 3 a typical 30,000-volt rural line is shown. At the foot of the nearer pole, a Durafour ferro-concrete support will be seen. The middle pair of poles are supporting a 30,000-volt three-phase interrupting switch.

It has always seemed to the writer that one of the most effective ways of reducing the cost of overhead line construction is to do all possible work in the factory instead of on the job. French design is certainly tending in this direction. For instance, all the better type of ferro-concrete supports eliminate bolt holes. In fact,

The illustration shows a pole mounted on a Durafour ferro-concrete support and an overhead interrupting switch.

Fig. 3.—A typical French 30,000-volt Line.

Fig. 4.—The S.F.A.C.A. Boltless Ferro-concrete Pole Support.

in one pattern—the S.F.A.C.A.—no bolts are employed at all. This type (fig. 4) looks very like the familiar drain pipe. The pole is centred by wooden wedges and then fixed in position by concrete tongues between the wooden wedges.

A very ingenious and simple method of constructing the insulator supports and arms is the Saignol system. In accordance with this system all the parts are made

out of bent round-steel rod without forging. Figs. 5 and 6 give an idea of the principle. Coach screws or bolts are passed through the loops formed in the bent rod to secure it to a post or bar.

Another clever system is the Mahaut, in which all parts are attached to posts or crossbars by galvanised steel U bands or bolts. The square section insulator supports are nicked to take the U bolts. Thus, with this system all drilling of post tops or cross arms is avoided.

Again referring to the previous notes on the Estrade portable friction drive for farm machinery, two illustrations (figs. 7 and 8) are given herewith, which show this clever portable motor and special friction gear unmounted and in place respectively. All those who have had practical experience of how farm labourers misuse belting will appreciate the importance of such a drive as this for farm work.

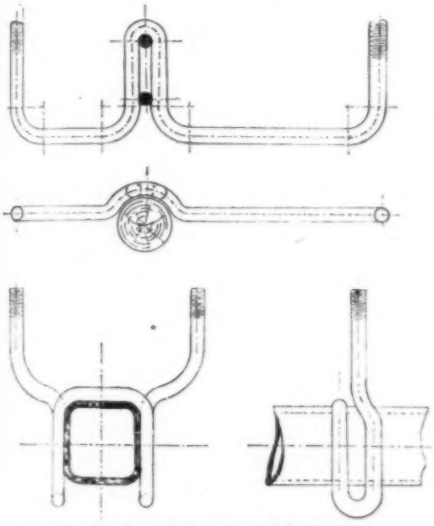
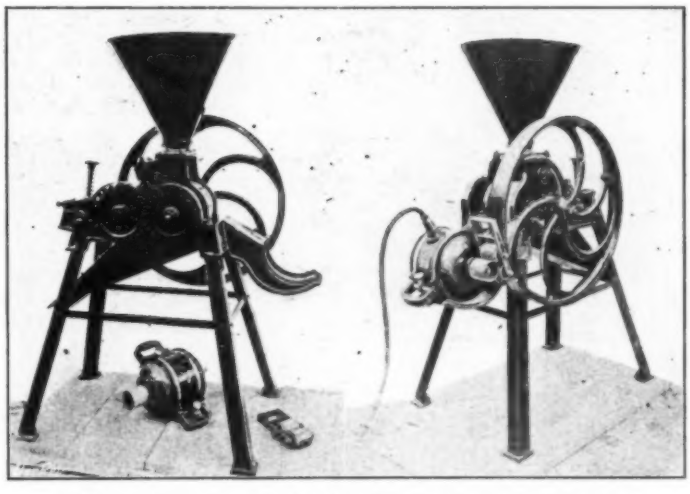


Fig. 5.—Saignol Round-rod Pole Fitting.
Fig. 6.—Saignol Round-rod Fitting for Cross Arms.



The portable motor and special friction drive pulleys can be seen on the ground. The cradle, ready to receive the motor, forms an integral part of the machine.

Fig. 7.—The Estrade Portable Friction Drive.

Fig. 8.—Grain Crusher ready for operation.

The concluding scenes of the Lyons Congress were even more interesting than the opening ones. In addition to the Premier, M. Herriot, three other Ministers attended, as well as the ex-Minister of Agriculture. So the affair certainly had the official blessing of the French Government. In addition to the large crowds that visited the exhibition, there were 300 official delegates to the Congress. M. Boret, the ex-Minister of Agriculture, made the statement, which is not without a good deal of truth, that the French peasant farmers were the bankers of the country, and had now further become the bankers of French industries. France is apparently convinced that it is going to pay her better to consume home-made electricity than to burn foreign-produced oil. French engineers have been astonished at the much greater consumption that has been attained in rural districts than had ever been expected. Of course, at a conference such as this, one meets the enthusiasts of the cause—the others stay away. However, with all due allowance for this commendable enthusiasm, one could not help realising that there was a great deal in this vigorous attempt to electrify the rural districts of France. The results are already better than were originally anticipated, and the nation is backing the idea wholeheartedly. So it will not be long before electricity is available in all parts of France. It will certainly ameliorate the conditions of living in the country. Rural industries are already springing up, which will in time even attract workers from the towns. Pessimists, of course, say that the electrification of France is merely a political move to ensure for herself a strong and healthy reserve of men for her armies—by deduction they admit that the use of electricity in the country is going to bring about strength and health. Given this, what more can a nation require? and if the employment of electric power encourages it, truly rural electrification is well worth while. It is to be hoped that wars will be non-existent in future, and hence will not sap any country of its electrically-provided health and strength.

Tidal Power Installations.

By A. J. V. UNDERWOOD, M.Sc., A.M.I.Chem.E.

THE appointment of a committee to inquire into the possibilities of the Severn barrage scheme has directed public interest again to the fascinating possibilities of utilising the immense potentialities of tidal power. Most schemes and discussions on this subject have been based on the generation of power by means of low-head water turbines. It is realised that this method involves serious disadvantages on account of the change in the direction of flow with the rise and fall of the tide and the constant variation in head under which the turbine operates. The schemes for overcoming the difficulties involved in operating the turbines during both tides entail considerable complication of the construction and a disproportionate increase in the capital cost of the installation. In consequence, the balance of opinion is in favour of forgoing the energy which is available during the filling of the reservoir at rising tide and driving the turbines only during the falling tide by means of the water stored in the reservoir. In his study of the subject in *Engineering* (December 3rd, 1920, *et seq.*), Professor Gibson comes to the conclusion that "the scheme (one-way operation) is essentially more simple than any one involving double-way operation, and the balance of advantages would appear to be heavily in its favour." The use of water turbines, therefore, involves the sacrifice of half the energy available in any practicable scheme.

An alternative method of utilising the energy of the tides, which is claimed to overcome the difficulties inherent in the use of water turbines, and which is

receiving considerable attention on the Continent at the present time, consists in the use of hydraulic compressors. In this way a supply of compressed air is directly available and is used for driving compressed-air turbines. A diagrammatic sketch of the type of compressor is shown in fig. 1, which represents a cross-section through the storage dam M. Chambers S, *a*, B, K are formed in the dam, and S is connected with the sea by means of the passage *f*, while B is connected with the water in the reservoir by means of the passage *e*. Also the chambers S and B are connected with the chambers *a* by means of the passages r_1 and r_2. Between *f* and r_1 and between r_2 and *e* are adjustable weirs w_1 and w_2, which are attached to the floats *m* so that they are automatically operated by the changes in water level. In the floats *m* are fitted air suction arrangements c_1 and c_2. The method of operation is as follows: At flood tide the water in the sea (right of dam) stands at a higher level than the water in the reservoir (left of dam). The water therefore flows through the passage *f* and the space S, as indicated by the arrow, and during its passage sucks in air through c_1. The mixture of air and water passes down the passage r_1 into the chambers *a*, where the air and water are separated, the water then passing out through r_2 and *e* into the storage reservoir.

In this way the reservoir is filled during the flood tide. As soon as the ebb begins and the water in the sea (right of dam) is lower than the water in the reservoir (left of dam), the direction of flow through the compressor changes, the mixture of air and water passing

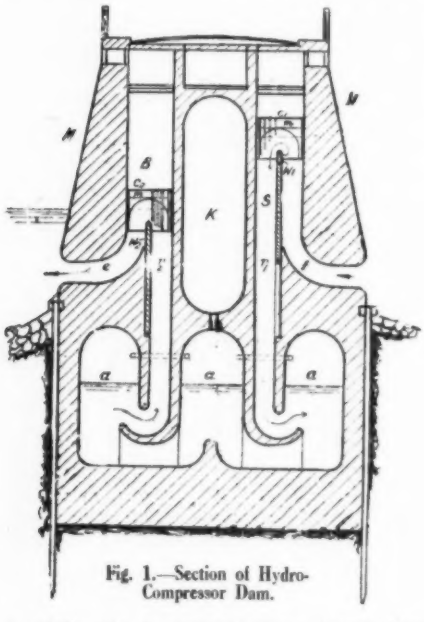


Fig. 1.—Section of Hydro-Compressor Dam.

down r_3, while the de-aerated water leaves through r_1 and *f*, the air being separated as before in the chambers *a*.

Thus, without any complicated regulating apparatus, such as is necessary for the operation of water turbines during both tides, the hydro-compressor in this arrangement compreses air equally during the rising and falling tides and is regulated automatically.

The compressed air is led to compressed-air turbines which can be installed on the land. In small installations it can be conveyed by pipes, and in large ones by means of the canal K formed in the dam itself, and serving also as a collecting chamber for the compressed air from the various series of chambers *a* situated along the length of the dam.

At the change of tide, when the difference in water levels in the sea and reservoir is small, the flow through the compressor is interrupted until an appreciable difference in levels is again established. This interruption is easily effected by raising one of the suction heads c_1 or c_2 and the attached weir, so that water no longer flows over the weir.

The pressure of the air separated in the chambers *a* is that of a water column equal in height to the difference between the water level in the chambers *a* and the level of the water after it has left the compressor. This pressure is therefore determined only by the construction of the compressor, and is independent of the head of water used for operating the compressor. In general, a working pressure of from $\frac{3}{4}$ to 1 atmosphere would be suitable for the compressed-air turbines. This would require a difference in the levels of the outlet water and the water in the separating chambers of about 25-35 ft. This would not, as a rule, necessitate the construction of a dam of greater depth than would be required by considerations of the stability of the dam and the finding of a suitable foundation level. If long air leads to the turbines should be necessary, the compressor would naturally be worked at a pressure slightly higher than that required for driving the turbines to allow for the drop in pressure through friction in the pipes.

Comparison Between Water Turbine and Hydro-compressor Systems.

The construction of the dam for the installation of hydro-compressors is of greater simplicity than that required for the settings of water turbines, and consequently the initial cost is less in the former case.

The hydro-compressor has no moving parts working under water and subject to wear and corrosion. The slow rise and fall twice daily of the movable weirs causes practically no wear of these parts. The whole compressor installation therefore requires considerably less inspection and supervision than a water turbine installation. The compressed air is produced by isothermal compression, and therefore suffers no loss in pressure through cooling during transport to the compressed-air turbines. In view of the suitability of compressed air as a means of transmitting power, the whole of the machinery, *e.g.*, turbines, electric generators, transformers, &c., can be situated on land. The location of electric generators in the dam, as would be necessitated by the use of water turbines, is open to considerable objection both on account of the resultant complication of the dam construction and the greater liability to depreciation of the generators.

Furthermore, the compressed-air turbines being situated on land, can be constructed in larger units than the water turbines located in the dam. The initial outlay and working costs are therefore smaller in the former case.

On account of the variation in the head, the speed of the water turbines must vary considerably. This is a serious disadvantage for the generation of electric power for long-distance transmission, as the variations in speed will necessitate the use of direct-current generators with rotary transformers for the production of alternating current.

By the use of compressed-air turbines these disadvantages are eliminated. In spite of the alterations in water level, the turbines will work under constant pressure, and consequently constant speed, and they can therefore be coupled directly to high-frequency alternating-current generators.

The variations in head and quantity of water do not affect the efficiency of the hydro-compressor, which is constant at about 80 per cent. Neither is the efficiency of the compressed-air turbines affected, as the supply of air is always available at constant pressure. On the other hand, the efficiency of water turbines is seriously affected by these variations, and consequently, in spite of the double transformation of energy, the system of hydro-compressors and compressed-air turbines will not have a lower overall efficiency than the single transformation of energy by means of water turbines. Furthermore, in view of the transformation of direct into alternating current necessitated by the latter system, efficiency considerations are very much in favour of the former system.

Suggestions have been made to overcome the difficulty of variable speed for driving the electric generators by coupling the water turbines to centrifugal pumps for pumping water to a supplementary reservoir and

utilising the supply of water at a constant head for driving high-speed turbines directly coupled to alternators. This method can scarcely be considered practicable, however, in view of the large capital outlay which would be involved in the construction of the supplementary reservoir and conduits, the low overall efficiency, and the difficulties of access to the pumps for inspection purposes.

A further suggestion for equalising the output of the compressed-air turbine installation consists in heating the air during the time at which the tide is changing. Of course, a large supply of compressed air is available in the storage and separating chambers in the dam, but if cheap, low-grade fuel is available it might be advantageous to use it for preheating the air fed to the turbines. Exhaust or waste heat generally might be used for the same purpose.

The brief description given above is sufficient to indicate the attractions of the hydro-compressor system for the utilisation of tidal energy and its advantages in the essential considerations in any such system, *viz.*, capital cost, simplicity of operation, and efficiency. The successful working of hydro-compressors up to several thousand horse-power in America and on the Continent has taken them beyond the experimental stage, and it is hoped that the Severn Barrage Committee will include the consideration of this system in its field of inquiry.

The first plant of this kind was installed at Magog, Quebec, five and twenty years ago, and gave 100 horse-power, with an efficiency of 71 per cent. A plant with a capacity of 5,000 horse-power was installed at the Victoria Mine, Michigan, some years later; the efficiency of this plant was 82 per cent. These plants derive their power from rivers, but the application to tidal power follows immediately.

Increased Production—Decreased Unemployment.

In our leading columns to-day we refer to the desirability of the problems arising in connection with the important national industrial subject indicated by the title of this article being searchingly and sympathetically studied by all of our readers. It is greatly to be hoped that in the new and more settled atmosphere that now obtains in a political sense all interests concerned may be willing to contribute their part towards the common task of surely, if gradually, bringing about a healthier and more prosperous industrial situation.

To assist our readers we set forth in the following notes the views of an expert in manufacturing and organisation.

The basis of the proposals mentioned in the leading article in this issue is that coal and iron must be sold at a price lower than at present ruling, and this reduction of price is not to be achieved by limitation of profit or reduction of wages, but through increased output. The first move toward attainment of this object must come from the employers. First, they must compute what the minimum weekly output for a fixed number of employés must be to enable them to sell coal at such a reduced price as will revive trade. Then it is for them, with the financial assistance of Government under an extension of Trade Facilities Act if required, to arrange to produce that minimum output regularly for stock if necessary at first. Then they must assure their employés continuous employment on condition that the predetermined weekly output is obtained regularly, and we are sure from our knowledge of British workmen that with this assurance of settled employment they will give the increased output required.

The railways could then be approached to carry this bigger volume of coal at reduced rates. Coal produced under these conditions could then be sold at a lower price to, amongst others, the steelmakers. Similarly, if the Government financed the stocks of the large steelmakers, with similar provision as to the selling price of steel, the steelmaker, having his coal at a lower price, would be able to approach his men on similar lines to the coalowner, namely, that, provided a certain production of steel was obtained with a certain number of men, they would be assured of so many years' employment. Thus the steelmaker would be able to sell at the price arranged.

The effect of such a policy would be cumulative, because cheap fuel should and would mean cheaper transport and cheaper power. With regard to the latter, the provision of improved electrical power arrangements should be pushed forward with all possible speed by the Government.

Particular notice is drawn to the fact that the fundamental basis of these suggested schemes for the revival of our basic industries of coal and iron is not a reduction of wages, but the retention of the workers' wages at their present level, provision being made for regular employment, provided a certain output of coal or steel is obtained within existing working hours, the idea being that if the insecurity of the worker is removed there is no hindrance to production. This is no theory, but is based on actual practice, of which there are several examples, an excellent one being that of the Ford Motor Co.

We have outlined this scheme for the engineering industry, but it can be equally applied to other industries. This policy, if followed, would have a cumulative effect, as, of course, lower prices must ultimately mean increased sales, and still further impulse would be obtained by extending the Trade Facilities Act to press forward the great possibilities in connection with the electrification of railways. When one realises the small amount of progress made in this direction during the last few years and the immense possibilities, it reflects no great credit on either the Government or the railway companies. Here again, a courageous policy is needed by definite provision being made to develop the electrification of railways at a rate of several million pounds a year for several years. The prospect of this steady work in the shops of our big electrical manufacturers would enable them to approach the question of prices from a very much sounder standpoint as they would then be in a position to distribute their manufacturing and commercial overheads over a bigger output than they are probably at present producing, which in itself would immediately make a reduction of price possible. This, coupled with the suggested development of the coal and iron industries, would, by its snowball action in the development of trade, make it possible for the cost of railway electrification to be reduced to a figure which would make it a sound economic proposition.

The net result of the whole would be that money which is at present being spent on unemployment doles and many non-economic employment schemes would be diverted to sound commercial propositions, which, in turn, would assist the development of our industries generally.

Before closing our references to the great things that can assist industry, we must refer to the possibilities

of our great Empire if the right sort of policy and encouragement is initiated by our Governments.

Those who have had the advantage of visiting the United States of America and studying the condition there of general prosperity, and particularly the stability of employment, and know that this has been brought about by a union of States working for the common good, realise the possibilities in the development of our own Empire as a union of States on similar lines. Our natural resources are even greater than those of the United States. The development of the Empire on these lines must on no account become a question of political or party jealousies and quarrels, but must be a continuous development to the advantage of its citizens.

Summarising our views as to the revival of the "roots" of industry we suggest that it can be accomplished:—

1. By the Government, in conjunction with our great coal and iron industries, through extension of the Trade Facilities Act, financing manufacture for stock of our basic materials, coal and iron, with provision as to minimum output.

2. By the Government pressing, in conjunction with the railway companies and the manufacturers, for continuous development in the electrification of our railways, and assisting in the financing of such work through an extension of the Trade Facilities Act arrangements.

3. By the Government studying and furthering the development of our Empire on the lines of a union of States for the common good.

Having outlined steps to revive the "roots" of industry, we will refer to other important matters that help materially towards minimum manufacturing costs. One of the complaints of Labour is that it does not get a share of the profits of industry. We will not discuss this contention, beyond, at once, referring to the results of efforts taken to satisfy this claim, and venturing to suggest that an excellent example of a profit-sharing scheme can be taken from the Ford Motor Co.'s history. Although examples of British manufacturers could be used, we mention the Ford Co. because that company is known to everybody, whereas the South Metropolitan Gas Co. and other concerns operating profit-sharing schemes are known only to a few.

In "Facts from Ford" it is stated:—

"The company believes that confidence and loyalty in the men can come only after the company has shown its confidence and loyalty towards the men.

"Henry Ford put ten million dollars back of his faith in the thirteen thousand men working for him on January 12th, 1914. He set aside that sum to be added to their wages under the profit-sharing plan.

"He shortened the day's work from nine hours to eight. He established right working conditions.

"Six years later his thirteen thousand men had grown to eighty thousand; his annual output of cars had gone from a quarter of a million to a million; he had distributed over one hundred million dollars in profits and had acquired, with his son, complete ownership and control of the company.

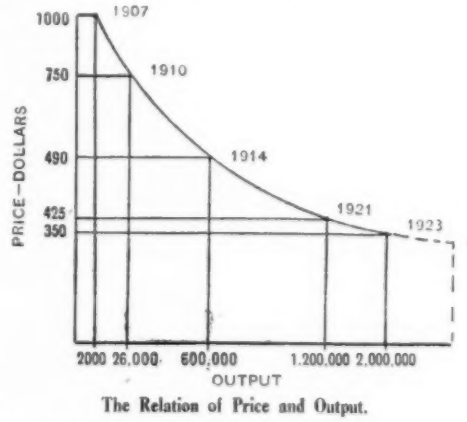
"His belief in his men stood the test of these six years, and on January 1st, 1920, announcement was made of the extension of the old profit-sharing plan of 1914 by the addition of the bonus and the investment plan, which put eight million dollars in their hands as a reward for their service during the preceding year and opened to them the opportunity of sharing further in the earnings of the company through the investment of their future earnings."

Mr. Ford states in the same publication that, before introducing his profit-sharing plan in 1914, his labour turnover was 50,448, whereas two years after the operation of his scheme it was only 2,000. A most valuable lesson is to be learnt from these figures, for to produce at minimum costs you must have a small labour turnover, which means minimum training of new hands, with all its attendant expenses for low production and high percentage of scrap and defective work.

We earnestly ask our readers to carefully consider these important facts, and not brush them aside with the excuse that they cannot be applied in their case, but, rather, to ask themselves: "What can I do to further these proposals?" which we know from experience (as that of the Ford Company) have proved a success. With every shoulder to the wheel, employers' and employés', industry must revive. The skilled manufacturing craftsman is admittedly underpaid for the skill that he has, as compared with many of the lower grades of municipal and transport workers, because industry cannot pay more. He, however, would come into his own by a profit-sharing scheme, not by alteration of the basic rate, but by direct return for his effort. Those who are in touch with working men realise that the majority are sound at heart, and willing to work in the interest of themselves and the company with which they are associated, provided they do not feel that by this effort they are only shortening the days of their employment.

The next question that needs consideration is, having provided for lower costs of basic material, and made suggestions to get loyal workpeople, what further can be done to help? We think that further consideration might be given by manufacturers and distributors to their business from the point of view of service to society. This may be a new outlook for many, but it should be realised that the basis of a sale is the need of a customer, and, further, that the cheaper an article the greater the demand. During this trade depression we are liable to move in a very vicious circle, or, perhaps it would be better to say, move along a curve of a parabolic nature, the reason being that low earnings mean a low purchasing power, and a low purchasing power means a small quantity of orders going through our factories, and a small number of orders means a greater minimum cost. A greater minimum cost, when this applies to the everyday things of life, means an agitation for increased wages, and the latter, again, means increased cost. In addition, orders being scarce in a shop, there is the false doctrine on the part of workmen of making work last in order to keep employment.

Enlarging on this question of service, we would like to refer again to the Ford Company. The foundation of this great business, employing 80,000 men, is service to the community, in that it supplies an article that is within the limits of the pockets of all branches of the community, including transport, manufacturing, and pleasure. The accompanying curve shows the tendency of the price and output. This is more remarkable because during those years the working hours of the men were reduced from nine to eight hours per day. Ford decided that if he could produce a car at a certain price, he could sell so many cars per year. Later he decided he could reduce his price and sell still more, &c. The reader may say that the Ford factory controls a very big percentage of its production from the iron-ore to the finished car, whereas, as already admitted in this article, the average electrical manufacturer does not control more than 50 per cent. of his actual cost, the remainder being the material under the control of other works. We have already helped to deal with this difference in our suggestion with regard to our basic industries, *viz.*, the raising of coal and the production of iron, steel, &c. We hope that all readers of this article will most carefully study and thoroughly appreciate this



The Relation of Price and Output.

most convincing example of the success of running a business as a service. If more of our factories and businesses could be run on these lines the continuous insecurity and fear of unemployment and the call for nationalisation would largely disappear. Of course, there would always be the fanatics and people with axes to grind who would continue to support the theory of nationalisation, but with employment ensured the greatest argument against the present order of society is removed and the question of excess profits is taken care of by proposals for profit-sharing.

These are our suggestions to the Balfour Committee and to the great industries of this country.

(To be continued.)

Smoke Abatement.

The Manchester Exhibition and Conference.

UNDER the ægis of the Smoke Abatement League of Great Britain, a conference on industrial and domestic smoke abatement was held at the Manchester Town Hall on November 4th, 5th, and 6th, concurrently with an exhibition of plant and apparatus calculated to diminish the production of smoke. Delegates represented a large number of municipalities, societies, and institutions, the Institution of Electrical Engineers being represented by Mr. J. W. Beauchamp, director of the Electrical Development Association. On the morning of November 6th a visit of inspection was paid to the Manchester Corporation's new electricity generating station at Barton.

The Exhibition.

THE chief electrical feature of the eleven-days' exhibition, which was opened by the Lord Mayor on November 4th, was the large display arranged by the Manchester Corporation electricity undertaking. Most of the material and labour for wiring the stands were furnished by the local branch of the Electrical Contractors' Association, and a large number of firms loaned the electrical apparatus on view, which, if brought into general use, will greatly assist in lessening the smoke nuisance.

Part of the exhibit was a series of seven rooms representing an electric house, the lighting of which was arranged by the Electric Lamp Manufacturers' Association. In the bathroom there were a "Highlow" water storage tank of the pressure type for the bath, a displacement heater for the wash basin, and an electrically-heated towel rail all by Messrs. A. Low and Sons. The kitchen was electrically heated on the John Lightfoot tubular system, which has an exterior resemblance to hot-water pipes, and contained two Jackson cookers and a hot-water tank over the sink; also a Western Electric combined dish washer and kitchen table, electric cooking being demonstrated twice a day.

The laundry was equipped by the Northern Steel and Hardware Co., with the exception of the "Blighty" wash boiler, which was of G.E.C. make. The use of the "Laundry Queen" washing machine and wringer was demonstrated, and amongst the accessories were noticed a "Komet" iron, immersion heaters, a vacuum cleaner, and the "Uranus" bed warmer illustrated in fig. 1. This aluminium device uses no water at all, thus the danger of leakage and scalding is banished; it contains an element suitably lagged, and is connected to a lampholder or wall socket for about 10 minutes, so that it can be touched comfortably with the hand. It is then entirely disconnected and placed in the bed, when it will continue to grow warmer for two hours and remain warm for another two or three hours. As no current flows through the warmer in bed, shocks are impossible.

Across the gangway another series of stands had been arranged by the Corporation and the Electrical Development Association to illustrate some of the applications of electricity. For instance, on the first were displayed several "Witton" polishers and grinders; Sturtevant portable and stationary vacuum cleaner plant; Hobart vegetable paring, dough mixing, sausage-making and mincing machines; a coffee grinder and an Ireland glass washer and polisher. On the second stand was a Mawdsley's rotary converter supplying a Leeds Electric Construction Co.'s furnace, with a maximum temperature of 1,350 deg. C., for heat treating carbon and alloy steels, and also a Wild-Barfield 3.4-kW automatic furnace capable of hardening 30 lb. of tools per hour at a cost (with electricity at 1d. per kWh) of 26s. per ton. It was provided with a silver wire "heating fuse," which melts at a certain temperature so as to prevent the furnace being left in circuit all night, for example. There was also a Canning 6-volt, 150-amp. electro-plating machine and an electric welder by British Insulated and Helsby Cables, Ltd.

A "Thor" electric ironer was shown with a Carron hot cupboard and double-oven cooking range, a G.E.C. restaurant grill, and a Westinghouse 1-phase, 220-V baking oven with a loading of 3.5 kW. Finally, on the last stand were displayed many heating, cooking, and lighting apparatus and novelties too numerous in make and type to mention individually. The Corporation had, moreover, arranged a model shop window so that the various forms of good and bad lighting could be demonstrated.

On the stand of Messrs. Crossley Bros. was a 5-b.h.p. gas engine driving a 2½-kW Newton's (Derby) generator for 100/140-V house-lighting purposes. Amongst other things the Fusion Corporation, Ltd., showed an electrically-driven dust arrester for extracting solid particles, or liquids in suspension, from air or gas. Messrs. Halliwell & Good, Ltd., exhibited lighting fittings, irons, toasters, fires, intercommunication telephones, radio sets and components, and a Boulton & Paul house-lighting set, while the goods on the stand of Messrs. E. O. Walker & Co. were somewhat similar in nature.

Amongst the articles shown by Messrs. Hirst, Ibbetson and Taylor, Ltd., were "Highlow" heating and cooking apparatus and break-baking ovens. In the cooker illustrated in fig. 2 (by Messrs. A. Low & Sons) the boiling rings are of the closed reflector type, the element being protected by a c.i. ring with a hole in the centre. Under the ring is a concave reflector to direct the heat through the hole in addition to its being conducted through the closed part of the ring. Instead of reflectors, a copper tank to hold 13 pints can be placed under the boiling rings, the top of the tank being dented to act as a reflector. Thus, the water in the tank is heated whenever the boiling rings are in use, and by using the water out of the tank for cooking purposes the overall efficiency of the range is claimed to be increased by 25 per cent. A 500-watt immersion heater can be fitted into the tank, if hot water is required when the boiling rings are not in use, and the tank can be connected to the cold-water supply main, or can be filled by hand. The loading of the boiling rings is 1,500 watts each; of the single-heat grill 1,500 watts; and of the 3-heat oven 2,500 watts; the dimensions of the cooker are 24.5 in. wide, 36 in. high, and 22.5 in. deep overall.

Fig. 1.—The "Uranus." Electric Bed Warmer.

Fig. 2.—"Highlow" Electric Cooker and Water Heater.

The other appliances for diminishing smoke that were exhibited comprised some boiler-house plant, a few patent fuels and oil, and much gas apparatus.

The Conference.

At the opening session, Mr. J. W. GRAHAM, chairman of the Smoke Abatement League, read a paper upon smoke legislation in England and America. It was followed by a paper by Mr. R. MORTON ROWE, chief smoke inspector, Manchester, on the possibilities of smoke prevention under the Public Health Act, 1875. The discussion was opened by Mr. C. E.

STROMEYER, chief engineer of the Manchester Steam Users' Association, who said his Association had made hundreds of experiments in smoke prevention, but he would like someone to explain what smoke was. Was it the visible smoke, black or brown, or was it the invisible waste gases which, in his opinion, were far more injurious? Coke made by the low-temperature process contained much more sulphur than coal and produced a far worse atmosphere. People might imagine they were remedying the evil by removing the blackness from the smoke when, in fact, they were increasing the impurities in the air. In his opinion there was very little need for compulsory powers; education had in many cases done much more than could have been accomplished by a strict enforcement of the law.

Mr. E. KILBURN SCOTT said engineers knew how to prevent smoke, but unfortunately people would not spend money on the necessary processes and methods. They should be compelled to do so, and legislation was needed. America had set the example; no bituminous coal was allowed to be burned in New York and Pittsburg was cleaner than Sheffield. Electric furnaces were used there to a tremendous extent and there was no reason why they should not be used in this country. Sheffield had some, but there ought to be ten times as many. Sheffield could easily produce crucible steel with coke properly made in regenerative ovens where there was no waste. The problem was going to be solved by electrical power.

A paper on air pollution was read by Dr. J. S. OWENS, and diagrams on measuring atmospheric pollution in a Lancashire town were explained by Dr. J. R. ASHWORTH, of Rochdale. In the evening Sir FRANK BAINES, director of H.M. Office of Works, spoke on the effect of atmospheric impurities on buildings, and Prof. COHEN, of Leeds, dealt with the work of the Departmental Committee on Smoke Abatement.

On the second day the subject of low-temperature carbonisation and smokeless fuel was dealt with; three papers were read: (1) A description of the smokeless fuel plant for Glasgow, by Mr. Robert MacLaurin; (2) Some new aspects of low-temperature distillation, by Mr. Harald Nielsen; and (3) "Coalite," by the Rt. Hon. G. H. Roberts, and Mr. P. C. Pope.

Dr. C. H. LANDER, Director of Fuel Research under the Department of Scientific and Industrial Research, said the papers set forth the views of three of the groups that were engaged in trying to bring about low-temperature carbonisation commercially. The local aspect related to the utilisation of slack and coal that was at present unmarketable. That would undoubtedly come first, but there was also the national aspect of how far it was possible to convert very large quantities of coal so as to make this country wholly or partially independent of foreign supplies of oil. The view of his Department and of the Mines Department on large-scale production was that no one could yet say definitely whether commercial success was possible. The likelihood of commercial success could only finally be judged after working plant under steady load for a long period, and in the light of a knowledge of local conditions, cost of raw material and labour, &c.

Following papers on the effect of light on health submitted by Mr. Leonard Hill and Dr. R. Veitch Clark, smoke abatement from the mechanical engineer's point of view was considered. Papers were read by Mr. T. R. Wollaston, M.I.E.E., on the complete gasification of coal, by Dr. J. T. Dunn upon pulverised fuel, by Mr. H. G. Clinch on the smoke inspector and the cost of production, and by Mr. J. T. Hodgson on smoke abatement and boiler-room economies in relation to the training of firemen.

Mr. A. MUNRO stated that at the Glasgow gasworks a Davidson arrester had been installed and 90 per cent. of the dust which otherwise would have gone up the chimney was now checked at the base. A test was made with six Babcock boilers burning ordinary gasworks breeze, and for every hour that the chimney was in operation one pound of ash was collected. The Brush-Ljungström pre-heater had been adopted from motives of economy, but it also, when judiciously used, made black smoke practically impossible. They were now getting 100 per cent. more out of the flue gases than could be got with the best economiser.

Mr. LHERMINIER believed that pulverised fuel was the only means of burning coal efficiently. The furnaces used with water-tube boilers were not properly designed; a boiler might be installed in a power station and work satisfactorily for two or three years; then, when the load increased, it became necessary to push the boiler, and the furnace would not stand that.

Mr. C. E. STROMEYER said that when boilers were called upon to do more than they were designed for, patent appliances might increase the power, but they would lead to smoke and boiler trouble.

Mr. A. BRADSHAW said that many firms which had to use oil during the coal-miners' strike would not have gone back to coal if oil had been obtainable at a reasonable price. He urged that central heating should be enforced in blocks of offices in large cities.

Mr. S. H. GIBSON said he had been connected with colliery people for the last ten years who used powdered fuel. It produced no smoke except when damp; there was no trouble in burning it; and it was easily manipulated. He was greatly in favour of powdered fuel.

Mr. E. C. MILLS agreed with Mr. Wollaston that the throwing of coal on the boiler fire should be abolished; it should be replaced by gasification of the fuel before burning.

(To be continued.)

Correspondence.

Correspondents should forward their communications at the earliest possible moment. ***No letter can be published unless we have the writer's name and address in our possession.***

A Modern Electric Flat.

Mr. S. Hall has fired his last shot and is satisfied that he has got me, because I will not agree to accept his challenge to a laboratory test of an electric *versus* a gas cooker. I will not accept his challenge for the simple reason that such a test, whatever the result, is absolutely valueless as a guide to the comparative value of gas and electricity for cooking in daily use in the average English home for reasons which are as well-known to Mr. S. Hall as they are to me.

What I am doing, however, is to continue to offer electric cookers on one month's free trial to any of my consumers for them to try against the gas cookers they are using in their homes under ordinary workaday conditions; the consumer pays for nothing but the electricity and is free at the end of the month to decide whether to continue the use of the electric cooker or not. Could anything be fairer?

The result of such tests in Hackney has been that exactly 95 per cent. of the cookers sent out are retained and preferred by the consumers to the gas cookers. These tests are quite practical and conclusive enough for me; I care not how strongly Mr. S. Hall or his friends maintain the opposite opinion. We simply agree to differ, but I am very satisfied with the progress electric cooking is making all over the country.

After all, this cry of dearness is only a repetition of what we had in the old days about light and power. The result will be just the same in due course.

L. L. Robinson,
Borough Electrical Engineer.

Hackney Electricity Dept., *November 7th*, 1924.

Wiring by Direct Labour.

My attention has been called to your leading article on page 643 of your issue of October 31st, 1924, on wiring by direct labour.

After carefully considering the arguments contained therein, I can only conclude that your correspondent has had little experience on the subject upon which he writes.

The argument "that wiring by direct labour is unnecessary and uneconomical" is not borne out by the facts, and to say the practice is wasteful is a slur not only on the business ability of the supervising staff, but also upon the workmen themselves. It is generally recognised that the wages and conditions of service are much better with a municipality than with an outside contractor. The workmen know this, and they also know that their continuity of service depends upon the financial success of the wiring department. For this reason they put the utmost energy into their work, especially when they know the price for the job is a cut one.

Your correspondent pleads that it is also wasteful to supply an office staff and experienced supervisors, but as a matter of fact it is because municipalities have an efficient office staff and skilled supervisors that direct labour is such a success. Many an electrical contractor has gone under owing to the lack of such a backing. However, an ounce of practical experience is worth more than a ton of theory, and the following examples are interesting:—

In my own undertaking almost the whole of the work throughout the borough is carried out by direct labour. The department has the excellent record of being successful in 99 per cent. of the jobs it quotes for in competition with contractors, notwithstanding its better conditions of service and sometimes higher rates of pay.

During the past few years the turnover in the wiring department has been in the region of £30,000; the accounts also show a reasonable profit. Some years ago, owing to a change in policy, the Electricity Committee decided to close down its showroom and wiring department. This decision resulted in a complete check to the progress of the undertaking, so much so that it was decided to open another showroom and wiring department, this time within a few doors of the competing gas company. The records show extraordinary progress from this date.

Diverting a moment from the electricity industry, another excellent example is found in the Council's policy in regard to its housing. On an estate in the S.E. area of London some 400 houses have been erected by contract. Recently, however, the Council decided to ask the borough engineer to submit a sealed tender in competition with contracting firms. This tender was just over £50 per house less than the quotation of any contractor, and the borough engineer was entrusted with the work. Most of the houses have now been erected, and some of them occupied months earlier than any contractor agreed to complete. Not only that, but the prices are working out slightly lower than the borough engineer's estimate. Surely this is a splendid example of the success of direct labour, which has been accomplished because the workmen knew the figure was a cut one, and they put their backs into the job to make it a success.

Every authority which has the provision in its Act to carry out installation work ought to do so. The consumers in

the borough know the stability of the Council, which has a reputation to keep up for efficient service.

The question of profit is subservient to all other claims, yet when that service is given and a profit accrues, there can be no argument against it. The gas companies know this, and that is probably why they never give any work out to contract.

It is difficult to raise "an objection to the diversion of the ratepayers' funds for such purposes which are wholly external to the functions of local government," because it is an absolutely incorrect and illogical standpoint. It reads more like an advocacy for vested interests as against progressive local development.

There is no diversion of anybody's money when the enterprise is successful, and to say that a wiring department is a purpose wholly external to the development of an electricity undertaking is an argument that can only be put down to gross ignorance. A successful wiring department is the backbone of the undertaking's development. Your correspondent, in touching upon one case of failure amongst hundreds of successful undertakings, is attempting to prove that "the less is equal to the greater," which, as Euclid states, "is absurd."

Enterprise.

November 4th, 1924.

[Our correspondent says he has carefully considered the arguments advanced in our leaderette, which explicitly stated that they were put forward by the Electrical Section of the Newcastle and Gateshead Chamber of Commerce in a memorandum addressed to the Council of the Chamber; to accuse the members of that Section of lack of experience of the subject is an extraordinary suggestion, which we are sure will not be endorsed by anyone who knows them.

For the rest, we expressly differentiated between the case of a municipality which is an "authorised undertaker" and the case in point, which is that of a municipality not already engaged in electrical trading. The former, as we showed in the leaderette, is technically competent and equipped for installation work, whilst the latter, of which the Gateshead Corporation is an example, has no valid excuse for setting up business in a highly technical trade.

"Enterprise" has completely missed the essential point of the leaderette, which was that the Corporation in question had no interest in electrical trading and no sound reason for embarking upon it. His arguments are therefore beside the point, and we may add that "to say that a wiring department is a purpose wholly external to the development of an electricity undertaking is an argument that can only be put down to gross ignorance" of what we wrote; for we never suggested anything of the sort, nor do we hold that view.

We are forced to the conclusion that "Enterprise" has been reading a comment on the matter in one of our electrical contemporaries which also missed the point, and has unkindly fathered it on us.—EDS. ELEC. REV.]

Wiring Regulations.

Allow me to thank your correspondents who have kindly taken notice of my letter on this subject.

I am glad to find that so much interest is being taken in the matter by many sections of the industry. Objections will be lodged by these sections against the "Ultra safety-first at any Cost" provisions which appear in the new regulations. These, I am sure, will receive careful and courteous consideration by 97.14 per cent. of the Wiring Rules Committee.

Dealing first with Mr. Atkinson's letter: I agree that the general public will not read the regulations, but I am sure the gas industry will rejoice that we ourselves are fettering our industry with increased costs, however small. The general public, however, unless these regulations prevent them using electricity, will have to pay for their effect, and that is where they come in. I don't think there is much in Mr. Atkinson's argument based upon American experience. Where are the British statistics to show that owing to fatalities and shocks these regulations are necessary? Not a single stand at the "Electricity in Service" exhibit at Wembley was wired to comply with the new regulations. The public walked on a rough concrete floor, we had all manner of voltages, but not a single accident or shock. Not an installation in Hackney complies with the new regulations, and we have never had any trouble in 23 years.

We look to the Institution for guidance but not for "law" in the shape of regulations.

Mr. Purse furnishes me with a capital analogy in support of my case in the motor-car industry. I should prefer to use a Rolls-Royce, but I can't afford it. However, thanks to cheaper, though perhaps less perfect, cars being available, I can motor and enjoy it.

What would be the state of the petrol industry if by "regulations" only cars of Rolls-Royce quality were permitted to use the roads? The Fords, Trojans, and Morris-Cowleys, &c., make motoring possible to the million and the consumption of petrol enormous, just as cheap installations will make the full use of electricity possible to the million. If by "regulations" we are only allowed "Rolls-Royce" installations, the acquisition of fresh consumers and the sale of lots more "juice" will be retarded.

I have not attacked individual clauses in the "Regulations," because my point is that we want recommendations, *i.e.*, guidance from the Institution—not regulations which are or may be law. But, if I were to deal with the regulations in detail, I should show that while many trifling "dangers" have been dealt with, more serious "dangers" have received no attention, and that in the end the whole question is best left to the common sense and judgment of skilled installation engineers.

I wish I could publish the letters I am receiving upon this subject and that so many people were not afraid to give publicity to their opinions. Nevertheless, I will risk a sample, but, of course, omitting the name:—

"We read with much gratification your letter in last week's '———.' We do not desire to appear prejudiced, but to our mind your letter was a reasonable and common-sense appeal to the profession. We suppose it is natural that we should take this view as we are '———,' but we can assure you that the number of nonsensical suggestions sent to us from highly placed and more obscure engineers concerning these '———,' in relation to the I.E.E. Regulations, would make your hair stand on end. This week we have recommended a couple of 'highbrows' to read your letter, and we can assure you that you have unconsciously done us considerable service by having the courage to give your views on this matter."

No! Sirs, the cost of the unit, within limits, does not matter much; in fact it is better kept so sufficiently high that plenty of "free service" can be given with it, but it is the want of really cheap installations with all unnecessary frills cut out that prevents the more rapid flow of orders from the man of moderate and small means with whom we have to deal to-day, now that we have already got the cream of the business.

I call to mind Æsop's fable of the "Frogs who asked for a King." Are not we electrical engineers rather like the frogs?

L. L. Robinson,
Borough Electrical Engineer.

Hackney Electricity Department,
November 4th, 1924.

Making Hay Without Sunshine.

My attention has been drawn to a paragraph in your issue of October 24th in which you say that the Institute of Agricultural Engineering has taken up Mr. Borlase Matthews's system of drying hay and corn, but that at a demonstration recently held no mention was made of Mr. Matthews's prior work in this field. You also state that there can be no doubt that the principle employed is the same.

In the first place, I am anxious to pay due acknowledgment to the pioneer work in applying electricity to agriculture which has been done by Mr. Borlase Matthews; but at the same time I must ask you to permit me to correct some of the statements made above.

The artificial drying of hay and corn by means of a fan was introduced in the 'eighties, but subsequently fell into disuse, to be again brought into prominence by the success achieved by Mr. C. Tinker in Scotland in 1918, and subsequently by the late Mr. W. W. Hood, of Chepstow, Mon. Following the successes obtained by these two gentlemen, the Machinery Section of the Ministry of Agriculture and Fisheries (which formed the nucleus of this Institute) was requested to undertake experimental work on the system. This commenced in 1923, when Mr. Matthews and others were practising a modification of the system originally revived by Mr. Tinker. The Ministry manifested interest in the experiments conducted by Mr. Matthews to the extent of supplying an observer, who was present throughout the whole time the stack was being treated; a copy of the observer's report was afterwards supplied to Mr. Matthews. The only appreciable difference between the systems of crop drying practised was that the Ministry used a single wooden central chamber and that Mr. Matthews employed four distributing chambers, and a central chimney for which no structures were used; in addition, the two ducts conveying the air from the fan to each pair of distributing chambers were sunk in the ground and provided with traps.

At the end of 1923 the systems, with the exception of the minor differences referred to above, may be said to have been more or less identical. But as the result of the experiments conducted during 1923, when 21 stacks were treated, it became apparent that some more rapid method of removing the surplus moisture would need to be employed. It had been found that although corn, bean, and pea stacks had been successfully dried with cold air, the system had not been so successful with hay, owing to the growth of mould on any parts of the stack where surface moisture had not been entirely removed. At the beginning of the 1924 harvest, therefore, the Institute had discarded the use of atmospheric air in favour of heated air; the system of employing a wooden central chamber was continued, and the laboratory work conducted throughout the winter had resulted in the production of a design which provided an even distribution of air throughout the stack. Other activities had produced a heating unit capable of heating a sufficient volume of air through a requisite number of degrees in a simple manner and at a reasonable cost.

Although commencing at a more or less common starting point, the difference between the two principles employed is

now so pronounced that, apart from the fact that a fan is used, the systems at the present time have little in common.

From the foregoing it will be apparent that the development of the system of crop drying from its condition at the beginning of 1923 to that recently demonstrated has been due alone to the Institute's own labours, and consequently there has been no necessity to mention Mr. Matthews's name.

B. J. Owen,
Director, Institute of Agricultural Engineering, University of Oxford.

Oxford, *November 4th*, 1924.

Our Debt of Honour.

On November 11th the thoughts of all of us will turn irresistibly towards the Great War and the men who won victory and ensured safety for the Mother Country and the Empire.

From time to time appeals have been made to those in authority, whether in commercial or professional firms, to provide employment for ex-officers, and very satisfactory results have been attained.

Over 79,000 ex-officers and educated ex-Service men have been assisted by the Appointments Department of the Ministry of Labour to find appointments. The number remaining on the register is 2,300, and it is on their behalf that I venture to appeal to your readers. The aim of my Committee is to find suitable work for these men immediately, and I believe that a renewed effort on the part of employers and the public generally would result in a solution of this national problem.

The register covers men of every qualification; men who, but for the war, would doubtless have been holding honourable and responsible positions in business life. Many are very near want, and are suffering the greatest of all tragedies, that of being unable to provide adequate support for their wives and children. Employment is the only and true solution, and it is the one thing the men ask for.

There must be many who can help us, directly or indirectly, whether by notifying us of vacancies or by calling the attention of employers to this appeal. May we not count upon all such to do their best for us in the knowledge that they will be materially assisting to pay the country's "debt of honour" to the men through whose sacrifices she was saved?

Vacancies should be notified to the National Appointments Committee, 3 & 4, Clement's Inn, Strand, W.C.2. (Telephone: Regent 5220.)

W. A. Bulkeley Evans,
Chairman, National Appointments Committee (Ministry of Labour and Officers' Association.)

London, *November 6th*, 1924.

Electrical Heating.

The electrical heater for small rooms, heating by radiated light, is a common feature to-day, and I wish to make public a method I used for several winters in my own home for increasing the efficiency of this device.

The heat when one stands in the line of the reflected rays is quite satisfactory, but it requires a very long time to heat a large volume of air.

I solved the matter by introducing convection by means of screens of thin metal. The final development is the following:—

A frame is made of wrought-iron tubing, with plainly made feet of the same tubing bent outward to form a base. The frame is painted dull black to make it artistic. Within the frame is hung a sheet of polished brass or copper plate, No. 26 or 27 gauge.

On the front and also on the back of this sheet is attached a sheet of metal lath, also No. 26 or 27 or even 28 gauge, of the type which goes by the following names in the market, namely, "Self-sentering," "Hy-rib," "Trussit," "Jhilmil," &c., these being trade names of various manufacturers for metal lathing with vertical projections which serve as furring. The furring projections are placed upright, so they serve as chimneys. When this metal lath is painted a dull black, the whole outfit has a very artistic appearance.

The apparatus is placed in front of the reflector, at any distance desired, but preferably at first not more than three feet away, so that it heats up. The warm air then begins to rise, the movement being accelerated by the chimney-like projections. Within a remarkably short time the whole room is benefited, for the rising sheet of air causes a movement of air throughout the room.

No claim is made that the amount of heat is increased, but actual use of the apparatus for some time has demonstrated that it causes the air within a room to circulate, and thus it renders the reflecting type of heater more efficient than it ordinarily is. It should be as useful for reflecting gas heaters as it is for electric heaters.

In the United States, where all our homes are heated by furnaces placed in the basements, the small electric reflecting heater is used for bathrooms during the late fall before the furnaces are started and in the spring when the furnaces are not used, but when there is a slight chill both morning and evening in the air. It is used sometimes also for warming other rooms which may not be equipped with gas fires or fireplaces. It was there I developed my idea, and now that I am living in England I expect to have use for the device in connection with my gas grate.

The idea, I believe, is worth considerable publicity, for I have no intention of applying for a patent. It is possible that the extended use of this apparatus may affect considerably the sale of reflecting electric heaters.

Ernest McCullough.

London, *November 3rd*, 1924.

Radio Transformer Characteristics.

I am now in a position to quote an authority (and one who is not tainted with any commercialism) on the requirements in a l.f. transformer, and it will be seen that he fully bears out my contentions. I quote below from the articles in *Experimental Wireless* by Mr. D. W. Dye, of the N.P.L.:—

"The most important single property of an intervalve transformer is the inductance of the primary winding. At low frequencies (below 300 cycles per second) an amplification as great as 75 per cent. of the maximum cannot be obtained on a step-up transformer unless the primary inductance is in the neighbourhood of 20H. This value is not usually attained in practice in the writer's experience, but it should not be impracticable if a somewhat larger iron section is used and if the stampings are carefully annealed after all mechanical treatment is finished."

(This is done in the case of a transformer I have mentioned.)

"Amongst the transformers tested for their constants the widest variations in these have been found, thus values of primary inductance between 2 and 15H . . . . . thus indicating considerable differences of opinion or *lack of knowledge* as to what is desirable under various conditions."

(The italics are mine.)

The concluding paragraph of this long article is as follows:

"It seems quite certain, however, that intermediate transformers should provide an amplification curve as straight and flat as possible over the longest possible range of audio-frequencies."

D. V. Onslow.

London, *November 7th*, 1924.

The Improvement of Power Factor.

Abstract of an I.E.E. Western Centre Discussion.

At the meeting of the Western Centre of the Institution of Electrical Engineers at Swansea on November 3rd, Mr. R. G. Isaacs, B.Sc., A.M.I.E.E., University College, Swansea, introduced a discussion on "The Improvement of Power Factor." Mr. W. Nairn (chairman) presided.

Mr. Isaacs said the improvement of power factor was still a vital problem in many areas, and from the power supply authority's point of view it seemed desirable that there should be a good analogy that would explain the position to non-technical consumers. The worst cases arose where underloaded induction motors were used, and low-speed induction motors also had a much lower power factor than high-speed machines. The disadvantages of lower power factor were enumerated, and Mr. Isaacs then gave six suggestions for improving p.f., namely: (1) Synchronous motor running light; heavy first cost coupled with running charges would generally rule this solution out. (2) Loaded synchronous motor; if a synchronous machine could have its power utilised for some definite purpose so that it was acting partly as a motor and partly as a phase advancer, this solution was a very efficient and reasonably cheap one. (3) Rotary converter; if the machine was run at unity power factor the proportion of wattless load to watt load was reduced and the general power factor improved. (4) Rotary phase advancers; if the rotor was selected they had the advantage that the wattless current was supplied at low slip frequency and voltage with the result that the kVA required was only a small fraction of the amount that would be required at line frequency; the simplest phase advancer of this type was the Scherbius, which consisted of a commutator machine having three brushes but no stator. (5) Vibrating phase advancers of the Kapp type, which consisted of an armature in a d.c. field; if the low-frequency current was passed through the armature it oscillated, generating an e.m.f. leading the current by 90 degrees; this would advance both rotor and stator currents in the same way as the previous type. Phase advancers, either rotating or vibrating, seemed the ideal method of phase advancing owing to the fact that every wattless kVA introduced into the rotor circuit was as effective as from 20 to 40 wattless kVA introduced into the stator circuit. Why was this method so little used? (6) Static condensers; those of the Mansbridge type had the advantage of requiring no attention and the loss in them was extremely low (less than ½ per cent. of the kVA injected). As to the choice of solution Mr. Isaacs said that for large motors (above 100 h.p.) the best solution in almost all cases would seem to be the phase advancer. Not only was the power factor improved, but also the characteristic of the motor, and the cost was only a small fraction of the cost of the motor. For a group of small motors, if there was no power demand which called for a synchronous machine that could take a leading

current to balance the lagging current, the only solution was condensers in parallel with the induction motor load. Finally, from the point of view of both consumer and supplier, a tariff that made allowance for varying power factor was the only fair one. The tendency of supply authorities to-day was to have a fixed charge for the maximum demand in kVA, together with a flat rate per kWh. On the other hand, in a district where there was a good diversity factor, a tariff based on kW-hours and the difference between kVA-hours and kW-hours would seem to be equally effective and could be more easily understood. The difficulty had been the lack of a kVA-hour meter, and in this connection Mr. Isaacs described a new type of kVA-h meter. The paper was illustrated by lantern slides.

Mr. W. J. BURR opened a lengthy discussion and said, with regard to tariffs, that he preferred to fix a rate and allow a rebate if the power factor was improved. That seemed to him more satisfactory and came to the same thing in the end. If a consumer required current for magnetising purposes he should be prepared to pay for it, although it was not actually recorded on his watt-hour meter. One point that had never been dealt with in discussion or in any paper was the dangerous condition which might arise under certain circumstances in producing unity power factor. Under certain circumstances if the power factor were raised to unity or slightly leading, dangerous conditions in the circuit might be set up which might not only affect the consumer's installation, but might affect the whole system. That, he thought, should be borne in mind. Mr. D. Jenkins, Mr. New, Professor Bacon (Swansea University College), Mr. Kerwick, Mr. H. Knowles, Mr. Allen and others, took part in the discussion, which for the most part centred on the question of tariffs.

Reviews.

A Three-Valve Receiver. By F. H. HAYNES. Pp. 8; nine plates and illustrated sheets. London: The Wireless Press, Ltd. Price 2s. net.

This is one of the "W.P. Ezi-Wiring Series" of booklets issued by the Wireless Press for the use of the amateur constructor. The set described is a straightforward three-valve set, consisting of a high-frequency amplifier, detector, and note magnifier, with reaction on to the aerial inductance.

The constructional details are given clearly, and the set is designed for the reception of waves between 200 and 2,000 metres, so as to cover the British Broadcasting Company as well as many of the European transmissions.

The set can be built up with a modest array of tools, a list of which is given, and in addition to full constructional details, the circuit and its operation are well described.

This booklet should be most useful to the constructor possessing a good foundation of technical knowledge.

Wireless Valve Transmitters: The Design and Operation of Low-Power Apparatus. By W. JAMES. Pp. 271; 210 illustrations. London: The Wireless Press. Price 9s. net.

The increase in experimental valve transmissions of recent years has been considerably handicapped by a lack of authoritative information on the subject. The keen amateur has had to work largely in the dark, guided only by such scraps of theory as he could pick up from the somewhat rare and invariably "patchy" articles which appear from time to time in the radio Press. The position for the man who knows little or nothing is even worse, for he cannot find sufficient data to enable him to acquire the basic knowledge which is necessary before he can properly appreciate the small store of articles at his disposal.

While several admirable publications are already available in connection with high-power commercial telegraphic systems of communication, there has hitherto been no reference book catering particularly for the small man. We therefore welcome this very timely treatise by Mr. W. James as being the first publication in this country to deal exclusively with the small power valve transmitter.

The author, who is one of the leading authorities on the subject of low-power transmission in this country, is well qualified to produce such a work, and it is refreshing to find that it is handled in an original and most satisfactory manner. Commencing with the rudimentary principles of electricity, the meaning of high- and low-frequency currents, inductance, capacity, and reactance are all fully explained and examples given in such a way as to make the veriest tyro feel thoroughly at home. In the chapters dealing with direct and alternating currents, many interesting and ingenious methods of obtaining high-pressure supplies are detailed, the rectification of both high- and low-pressure a.c. being particularly fully explained.

A very interesting section of the book deals with microphones and their associated amplifiers, the correct operating conditions for such devices being explained, and numerous circuits for speech control are also to be found. The various methods of modulation are detailed, and many practical suggestions are given for all types of valve transmitters.

A useful feature of the book is an appendix of considerable size containing much useful information on miscellaneous matters, such as the measurement of the capacity, resistance, and inductance of an aerial, the calibration of hot-wire meters, &c., and practical hints as to the use of inductance and capacity bridges, wavemeters, artificial aerials, &c.

A section is devoted to the all-important subject of aerial, earth and counterpoise construction and design, and in short no stone has been left unturned to provide a thoroughly comprehensive work which will be a constant companion to the enthusiast and a very noteworthy addition to his bookshelf.

We think that a few more actual constructional details of speech amplifiers, high-pressure transformers, and possibly electromagnetic microphones, &c., would have been useful, but otherwise the ground seems to have been well covered, and we are glad to welcome this treatise as a sound addition to the range of works on valve transmitters by British authors.

The foreword by Captain P. P. Eckersley adds a touch of interest, for no one is more closely associated with transmission problems or better able to understand the difficulties confronting the amateur.

A.L.M.D.

Factory Lay-out, Planning and Progress. By W. J. HISCOX. Pp. xi+184; figs. 37. London: Sir I. Pitman & Sons, Ltd. Price 7s. 6d. net.

A reader of Mr. Hiscox's work would be well advised to turn first to Chapter 4, and in considering this chapter should bear in mind the truth of the author's statement on page 62—"the higher the state of proficiency attained by the individual the more open is that individual to conviction, and the more inclined is he to give consideration to the opinions of others." In the same chapter, on page 65, the very sound statement is made that a bonus system is necessary to ensure economical production, but in an "all-out for bonus" attitude, work may be scamped unless proper planning, progressing and inspection are provided for. His remarks on page 67 with regard to vocational selection are well worthy of consideration by all employers.

After reading Chapter 4, we would suggest that Part II, Progress Work, be turned to next, and in Chapter 6 will be found some of the soundest advice on what to do and what not to do. For instance, on page 99, the author remarks that if the management considers records necessary, they must be up to date, and recommends that it should consider these records from time to time with a view to constructive action, thus eliminating the weaknesses of crude speeding up which often takes place at times of congestion, by removing the causes of the congestion. In this and other chapters the difficulties of the staff of a progress department are emphasised, and it is obvious that the author has had many hard knocks, both from management and foremen, &c. As a result, he is rather inclined to crude criticism, but if allowance is made for this, many lessons can be learned from the examples that he gives, if the question is asked by the individual reading the book: "Do I do this or does my staff do that? If so, then I must take steps to remedy it." His comments on page 102 are very valuable, namely, that the "'progress idea' must be exploited by men whose 'directness' is unquestioned, and who will not shrink from adopting the measures necessary to ensure success. This does not mean that the 'bullying hustler' is recommended, for he is at the other extreme, and in inefficiency he occupies a lowly position." A man of undoubted ability whose outlook is broadened by experience, a student of factory conditions and a keen judge of human nature, he suggests is the foundation for a successful progress department.

Chapter 8 refers to a suggested routine for dealing with various orders going through the shops, such as customers' orders, stock assembly, rush orders, repetition work, &c., and should really be read before Chapter 7, which deals with the suggested method of progressing parts through various departments. The latter chapter, of course, can only refer to a system which deals with the product of a particular factory, and the management of many factories may not agree with the details and the suggested arrangement.

Chapter 9 deals in detail with the principles mentioned as being the basis of the progress idea previously referred to on page 99. The example on page 158, second paragraph, of a test made by a managing director on a progress office is very interesting and very sound. On the next page the author refers to the difficulty in an industrial factory of overcoming the conflicting departmental interests, particularly when the head of each puts the blame on some department other than his own. If this paragraph causes individuals to cross-question themselves as to their attitude under similar circumstances, a lot may be accomplished. The examples of reports given in this chapter can, we think, be easily overdone.

Although many things of value may be extracted from the foregoing chapters, we are afraid the same cannot be said for the rest of the book, and this is why we have dealt with the most valuable sections first. In the first part of the book, the author hopes to interest "the big stars of the industrial firmament" as well as the "lesser lights." We are afraid that if the "big star" reads the book at the beginning, he will probably not go on to the end; the first chapter points out the shortcomings of the British manufacturer, particularly of the older organisations, which, although probably true, is expressed in such a way in the book that such an employer

reading it would probably become irritated and would not read further. No doubt these factories in their time were properly organised to deal with the product with the class of labour then available, and could not, therefore, be condemned from their inception, and a works organised to-day is not likely to be able to stand for 20 years without further alterations or additions, as most manufactured products change in design and processes of manufacture as a result of the changes in materials and research generally. The author should also realise that many of the older companies are carrying themselves well above water equally with newer establishments.

In Chapters 2 and 3, dealing with shop lay-out and the duties of an executive, the details referred to are described in such a cursory manner that they would have been better left out, but in Chapter 5 the author goes to the other extreme by giving charts and diagrams, of the merits and necessity of which no conclusive proof is given. Some are duplicated; for instance, the form shown on page 71, figure, 6, gives practically identical information to that shown on page 76, figure 7.

In Chapter 1 the author refers to the relations between management and staff in a most extraordinary manner. For instance, on page 4 he refers to the considered recommendation of certain heads of departments being turned down by a manager who he considers is inefficient and incapable of gauging the value of the suggestion. Certainly this is not typical of the average British company, nor is the average works manager the last man likely to detect what the author calls "rot."

The Calculus for Engineers. By E. S. ANDREWS, B.Sc., and H. B. HEYWOOD, D.Sc. (Paris), B.Sc. (Lond.). Pp. xi+269; figs. 102. London: Scott, Greenwood & Sons. Price 7s. 6d. net.

The dictum of Ecclesiastes xii 2 seems to apply with peculiar force to works on the Calculus written for the instruction of engineers, while the practical identity of subject-matter and similarity of treatment in most of the volumes of this kind which have for some time past flowed steadily from the Press suggests a comparison with the autumnal fall of the leaves in the forest of Vallombrosa, or evokes memories of the numerous commentaries on classical writers, the production of which occupied a large part of the leisure of Victorian scholars.

Many modern teachers have practical reasons for regretting the tendency of text-books to treat the various branches of mathematics in "water-tight compartments"—a practice against which Prof. Nunn continues to protest vigorously from the academic point of view. This current of opinion has not disturbed the authors, who begin by assuming a competent knowledge on the part of the student of algebra, including the theory of indices and of plane trigonometry to the solution of triangles, together with addition and product formulæ. In these prerequisites, however, they do not include the binomial or exponential theorems, and their treatment of exponential differentiation is almost unintelligible in consequence. Chapter III seems to be based upon a dogmatic, rather than a mathematical, process, and while the dogma is true, the truth is not obvious.

In the practical applications of the subject the authors follow well-beaten paths, and deal with a good number of problems in mechanics, strength of materials, and thermodynamics, capable of solution by simple integration. The well-written Chapter VII could be improved by the addition of a paragraph on torsion and another on the Carnot cycle. We regret that there is no similar chapter dealing entirely with electrical applications; the student whose interests are on the electrical side will scarcely be satisfied with the few examples of his work dealt with in the meagre section on differential equations. The equations arising in connection with the elementary theory of the dynamo, a.c. analysis, electrical oscillations, &c., are eminently suitable for solution in a book of this scope, and the reason for their exclusion is hard to find.

The concluding chapter on curvature and special curves is very well done, and there should be a footnote on page 187 referring students to it before reading Sec. 61. The printing is excellent, and the diagrams the best we have seen of their kind. The examples are numerous and well graduated, and the answers to each set are placed immediately after them.

For "cos 4" on page 164 read "cos 4θ."

W. P. WINTER.

Uncle Jack Frost's Wireless Yarns on Good Reception and How to Get It. By Capt. C. C. J. FROST, M.I.R.E. Pp. 106; figs. 23. London: The Wireless Press, Ltd. Price 2s. net.

This book consists of a dozen talks, which were broadcast by Capt. Frost, of the British Broadcasting Co., on the principles of wireless reception with a crystal set.

The author's wish was to give talks which would be understandable by the non-technical listener, and this he has done. He deals in a simple and chatty manner with fundamental principles, aerials, earths, telephones, crystals and accumulators, describing many of the troubles which beset the non-technical listener, and explaining how best to deal with them.

There is a good deal of repetition, but some of this is often useful for emphasising important points in a book of this kind which aims at being technically useful to a non-technical reader.

Business Notes.

Bankruptcy Proceedings.—J. L. FORD, electrician, 136, Queen Street, Great Harwood. Receiving order made October 30th, on debtor's own petition.

CYRIL PEACOCK, 51, Gillygate, York, electrical engineer.—The first meeting of creditors of the above was held on November 6th at the Official Receiver's office, Duncombe Place, York. The statement of affairs showed ranking liabilities of £227 and a deficiency of £79. Debtor attributed his failure to having to give long credit and lack of capital to keep the business going. From April, 1919, to May, 1920, debtor was in the employ of the York Corporation as an electrician, and between the latter date and the following November was out of employment. He then started his present business with £300 cash capital, part of which he expended on stock in trade, plant and other goods necessary for the business, while the remainder was used as required for business purposes. He appeared to have been able to pay his way only so long as the capital lasted, and when it was exhausted, he found that the turnover of the business was inadequate. By April, 1924, when creditors began to sue for payment, he realised his financial position. The case being a summary one was left with the Official Receiver as trustee of the estate. The creditors include the following:—

	£		£
Fuller's United Electric Works, Ltd.	41	W. J. Henderson & Son	24
General Electric Co., Ltd. ...	17	Metropolitan-Vickers Electrical Co., Ltd.	12
Edward Wright	20		

RICHARD EMMOTT, of Croft House, Morton, near Bingley, Yorkshire, formerly in business as an electrical engineer at Manor Street, Bradford.—This adjourned public examination was resumed on November 3rd at Bradford. The deficiency was stated to be £685, and much of the examination was devoted to close questioning by the Official Receiver as to alleged betting transactions. The Official Receiver said he regarded the case as one where a man was trying to evade the Act of Parliament and the results of his own folly and misconduct, and the Court should say that it would not permit debtors to fail to disclose frankly and fully their affairs on oath and under cross-examination. On the debtor's own application, the hearing was adjourned for the attendance of three bookmakers.

A. WOOD, electrical agent, 67, Bradford Avenue, Cleethorpes.—Receiving order made November 3rd, on debtor's own petition. First meeting, November 14th, at the Official Receiver's office, St. Mary's Chambers, Great Grimsby. Public examination, December 4th, at the Town Hall, Great Grimsby.

W. P. YOUNG (W. P. Young & Co. and the Leicester Tanning Machinery Co.), mechanical and electrical engineer, 40 and 42, Sanvey Gate, Leicester.—First and final dividend of 2s. 6½d. in the £, payable at the offices of the Trustee, Court Chambers, Friars Lane, Leicester.

Dissolution of Partnership.—MESSRS. H. HAUGHTON AND W. H. HANCOCK, trading as the Electrical Repairs Co., at Boad Street, Store Street, Manchester, have dissolved partnership. Mr. Haughton will attend to debts and continue the business.

Company Liquidations.—FYLDE ELECTRIC CO., LTD.—Winding up voluntarily. Liquidator, Mr. W. Snowball, 102, Church Street, Blackpool.

BRITISH HUSH-A-PHONE CO., LTD.—Winding up voluntarily. Liquidator, Miss H. E. Reeks, 19, Berkeley Street, W.—A meeting of creditors was called for November 11th. Particulars of claims to be sent to the Liquidator by December 1st.

WIRELESS CONSTRUCTION CO., LTD.—A meeting of creditors was called for November 13th, at 1 and 2, Great Winchester Street, E.C.

WIRELESS DEVELOPMENT SYNDICATE, LTD.—A meeting of members is called for December 15th, at the offices of the Liquidator, 1 and 2, Great Winchester Street, E.C., to hear an account of the winding up from the Liquidator, Mr. F. Morse.

Trade Announcements.—For many years FIAT MOTORS, LTD., have been sole concessionaires here for motor cars manufactured by the Fiat Company, of Italy. The latter company has greatly extended its production of other engineering manufactures, including rolling stock, Diesel engines up to 12,000 h.p., machine tools, &c., and a new company has now been formed to take over both classes of business here. It is styled Fiat (England), Ltd. The same management and personnel will be continued.

Mr. R. SCRUBY, who is opening premises at 9, Great Newport Street, London, W.C.2, asks for catalogues and price particulars of wireless sets and parts, general electrical apparatus, and aids for the deaf.

MESSRS. ROBERT W. HUNT COMPANY have changed their address from Queen Victoria Street, London, E.C.4, to 34-40, Ludgate Hill, E.C.4.

MESSRS. R., J. & H. WILDER have opened an electrical branch of their business in Wallingford, Berks., in connection with the recently-inaugurated hydro-electric scheme in that borough.

THE STELLA CONDUIT CO., LTD., has opened its own branch at 116, Pilgrim Street, Newcastle-on-Tyne (under the control of Mr. J. L. Maughan), where large stocks of conduit tubes and fittings will be carried.

THE META MANUFACTURING CO., LTD., has opened offices and showrooms at 70, Manchester Road, Chorlton-cum-Hardy, Manchester. Mr. O. Hauser, who has been appointed engineer and manager, wishes to receive catalogues and price particulars of electrical, wireless, and mechanical engineering materials.

Catalogues and Lists.—THE ENGLISH ELECTRIC CO., LTD., Queen's House, Kingsway, W.C.2.—Publication No. 306, containing illustrated details of the construction of transformers of capacities up to 1,000 kVA.

HOLOPHANE, LTD., Elverton Street, Vincent Square, S.W.1.—The November issue of "Illumination," a journal dealing with good lighting. This number treats of school lighting, and illustrates many applications of "Holophane" reflectors.

MESSRS. GEORGE SWIFT & SONS, LTD., Claremont Ironworks, Halifax.—List E, dealing with high-speed radial drilling, tapping, and studding machines; and List L, illustrating and describing all-geared-head lathes.

MESSRS. ED. BENNIS & CO., LTD., 28, Victoria Street, S.W.1.—A revised catalogue dealing with the Bennis patent chain grate and its applications. Fully illustrated.

THE FOSTER ENGINEERING CO., LTD., Morden Works, Wimbledon, S.W.19.—List No. L 60, containing illustrations and prices of lanterns for use with gasfilled lamps.

MESSRS. DRAKE & GORHAM WHOLESALE, LTD., 67, Long Acre, W.C.2.—A comprehensive, well-illustrated catalogue of radio components and accessories (Booklet No. 401). This contains illustrations and prices of condensers, variometers, batteries, aerial equipment, headphones, loud speakers, and a great deal of other apparatus.

THE ELECTRIC CONSTRUCTION CO., LTD., Ingersoll House, Kingsway, W.C.2.—An illustrated folder describing the company's press-button switches. Priced.

THE CARPAX CO., LTD., 312, Deansgate, Manchester.—A price list of radio sets and accessories; also a leaflet describing the "Kodel" portable receiving set.

MESSRS. A. REYROLLE & CO., LTD., Hebburn-on-Tyne.—A well-illustrated brochure produced as a souvenir of the British Empire Exhibition. This describes the company's works and products by means of articles reprinted from technical journals.

THE GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2.—Switchboard Catalogue (Section X1), containing full details, illustrations, and prices of switchboards (including cubicles) for all purposes, feeder and control pillars, &c. Also a coloured showcard advertising Marconi-Osram radio valves.

MESSRS. GENT & CO., LTD., Faraday Works, Leicester.—A folder advertising the "Pulsynetic" time-keeping system.

MR. PAUL DIENY, 20-21, Laurence Pountney Lane, Cannon Street, E.C.4.—An illustrated leaflet describing the construction and use of the "Soulier" battery charger for use on a.c. mains. This consists of a transformer and a vibrating-reed rectifier.

MESSRS. ERSKINE, HEAP & CO., LTD., Room 607, Australia House, Strand, W.C.2.—Pamphlet A.B.1 containing particulars and illustrations of air-break a.c. starters for star-delta or change-over.

MR. FRANK P. FAHY, 50, Church Street, New York.—A pamphlet describing the "Simplex" permeameter for the determination of the inherent magnetic properties of materials.

BRITISH INSULATED & HELSBY CABLES, LTD., Prescot, Lancs.—A general descriptive catalogue for electrical contractors, containing full particulars of wiring materials, cut-outs, switches, lightning conductors, lamps, radio aerials, &c.

THE NEW ITALIAN ART ASSOCIATION, LTD., 38, Newman Street, W.1.—Two illustrated and priced pamphlets advertising "Perlray" and "Britelite" lighting glassware.

MESSRS. S. BILL & CO., LTD., Queen's Road, Aston, Birmingham.—Two illustrated and priced pamphlets dealing respectively with quick-make-and-break switches and detachable teak fuseboards.

Swedish Activities in Russia.—*Commerce Reports* states on the authority of a Swedish journal that the Soviet Government has approved the transfer of shares to the value of $130,000 in the Russian combination, the Elektro-Selstroj, to the Swedish company, Allmänna Svenska Elektriska Aktiebolaget. The principal function of the Russian company is to supply power equipment in the Soviet Union.

Lantern Slides.—Those of our readers who may be preparing lectures for the present season may be reminded of the fact that Messrs. E. Bennis & Co., Ltd., of 28, Victoria Street, London, S.W.1, and Little Hulton, Bolton, have a large collection of lantern slides dealing with mechanical stokers and coal and ash handling plant, which they will be pleased to lend to societies, institutions or individuals. Printed particulars of the slides will be sent on application and, if desired, outline lectures can be furnished.

For Sale.—In the High Court, Chancery Division.—Allday and Onions, Ltd., Great Western Works, Small Heath, Birmingham.—Mr. C. H. Smith, the receiver and manager, invites offers by December 8th, for the above business as a going concern.

British Trade Mark Applications.—The following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from the dates mentioned. In the case of foreign applications, the names and addresses of the British representatives are also given.

Square Deal. No. 450,688. Class 5. Plain galvanised wire and telephone wire.—Keystone Steel and Wire Co., South Bartonville, Peoria, Ill., U.S.A. (Marks & Clerk, 57-58, Lincoln's Inn Fields, London, W.C.2.). November 5th, 1924.

Clear-Speaker (lettering and design). No. 449,056. Class 8. Wireless and other telephonic apparatus and parts of or accessories thereto.—Clear-Hooters, Ltd., Hooterland, Highgate Square, Camp Hill, Birmingham. November 5th, 1924.

Multicon. No. 450,457. Class 8. Wireless telephonic receiving sets and parts thereof.—Price's Battery & Radio Co., Ltd., 11, Hart Street, New Oxford Street, London, W.C.1. November 5th, 1924.

Amplion (lettering and design). No. 451,458. Class 8. Loud speakers.—E. A. Graham, trading as Alfred Graham & Co., London, S.E.4. November 5th, 1924.

Dragonfly (lettering and design). No. 451,460. Class 8. Loud speakers, Edward Alfred Graham, trading as Alfred Graham & Co., London, S.E.4. November 5th, 1924.

Supremam. No. 451,648. Class 8. Instruments for Wireless telegraphy and telephony.—Brahams (Houndsditch), Ltd., 90, Houndsditch, London, E.1. November 5th, 1924.

Hovimo. No. 452,006. Class 8. Apparatus for use in wireless telephony and telegraphy.—Holger Viggo Molback, trading as H. Molback, 27, High Holborn, London, W.C.1. November 5th, 1924.

Tandco. No. 452,249. Class 8. Instruments and apparatus for use in wireless telegraphy and telephony.—Turner & Co., 54, Station Road, New Southgate, London, N.11. November 5th, 1924.

Football Game design. No. 451,432. Class 13. Electric lamps (ordinary).—J. K. Smith, 40, Union Street, Glasgow. November 5th, 1924.

M (lettering and design). No. 444,508. Class 6. Electric fans, electric motors and generators, electric reciprocating engines, and electric vacuum cleaners and parts thereof. No. 444,511. Class 16. Push buttons for electric switches, cover plates for electrical wiring devices, attachment plugs and cord protectors therefor, current taps, attachment plugs and socket receptacles and brackets therefor, rosettes and insulators. No. 444,512. Class 18. Telegraph and buzzer installations, electric stoves, electric stove boilers, and electric burglar alarm installations.—Manhattan Electrical Supply Co., Inc., 17, Park Place, New York, U.S.A. (Fell & James, 11, Queen Victoria Street, London, E.C.4.). November 5th, 1924.

Officina Centium (lettering and design). No. 450,466. Class 50. An insulating material composed of granular cork and bitumen and sold in slabs, tubes, and sheets for use in cold storage chambers and for electrical purposes.—The Avamore Engineering Co., Ltd., 104, High Holborn, London, W.C.1. November 5th, 1924.

The Wembley Exhibition of 1925.—In the course of his speech at the Lord Mayor's Banquet on Monday night, the Prime Minister (Mr. Baldwin) referred to the question of continuing the Wembley Exhibition next year in the following terms:—The British Empire Exhibition has played an invaluable part in stimulating inter-Imperial trade and in extending knowledge of the British Empire among all classes of the nation. We do not intend that this great enterprise shall come to an untimely end. Practically the whole of the capital expenditure has already been incurred, and the cost of reopening the exhibition next year and allowing many more millions of people to see it will not be great.

"In this matter we do not stand alone, and we cannot ourselves assume the whole burden, but if the Dominions and the great industries of this country are prepared to do their part, we will do ours, and we will ask Parliament to provide a fresh and sufficient guarantee in addition to that already promised, provided that we are adequately and properly supported by the other parties concerned. We believe that, taking the long view of the future of our country, the assumption of this potential liability is fully justified, even in times when the strictest economy is indispensable in the public service."

Lord Stevenson, in a statement to *The Times*, subsequently said that the Prime Minister's speech meant that the continuance of the British Empire Exhibition next year was now assured.

A Radio Valve Campaign.—THE BRITISH THOMSON-HOUSTON CO., LTD., was one of the pioneers in the manufacture of radio valves, and the demand for these has reached a very high figure. The market is not saturated, however, and is continually growing and, consequently, the B.T.H. Co. has inaugurated a special advertising scheme to aid retailers to dispose of further quantities of its valves. Special leaflets, with spaces for retailers' names, have been prepared. A 15-in. by 10-in. show-card is being issued, and many attractive newspaper advertisements have been drawn up for insertion during the "campaign" in all kinds of journals.

A "Siemens" Prize.—MESSRS. SIEMENS & ENGLISH ELECTRIC LAMP CO., LTD., inform us that the "Siemens" 3-valve radio set offered by them as a prize in the *Daily Chronicle* "Happiness" photographic competition, has been won by Mr. G. F. Prior, of Highams Park E.4. Mr. Prior is an expert photographer who, hitherto, has not interested himself in "wireless."

Foreign Trade-Marks in Argentina.—The United States Commercial Attaché at Buenos Aires reports that in a recent case brought before the Supreme Court of Justice, on appeal from the circuit court of appeals, it was decided that the defendant was entitled to the exclusive use of the trade-mark registered by him in Argentina, although this trade-mark had been previously used in the United States and Argentina by the plaintiff and registered in the United States prior to defendant's registration in Argentina. The court remarked that a foreign trade-mark becomes property in Argentina only by registration under the Argentine law and not because of registration or use in the foreign country.

Book Notices.—"Lloyd's Register of Shipping: Report of the Society's Operations during the year 1923-24." London: Lloyd's Register.—This contains in the usual form a record of new shipping registered during the year and developments in design and propulsion. Mention is made of three Diesel-electric vessels, of which particulars have appeared in our columns. The publication also gives details of the personnel of the British and foreign committees.

Serial Reports of the Prime Movers Committee (Technical National Section) of the National Electric Light Association. No. 24-54, "Fuel Specifications"; No. 24-57, "Turbines"; and No. 24-60, "Oil and Gas Engines." New York City: The Association. Price 25 cents each.

"The *Journal* of the Junior Institution of Engineers." November. London: Percival Marshall & Co. Price 2s.—This number contains papers on "The Design of Static Substations, with some notes on their Equipment," by Mr. N. Thornton, A.M.I.E.E.; and "Explosions, Terrestrial and Celestial," by Prof. A. W. Bickerton, A.R.S.M. In addition there is a *résumé* of a lecture on "High-Voltage Electrical Oscillations," by Mr. R. P. Howgrave-Graham, M.I.E.E.; the annual accounts; reviews; membership elections, &c.

"The *Journal* of the South African Institution of Engineers." October, 1924. Johannesburg: The Institution. Price 3s.—The bulk of this issue is occupied by a paper entitled "Notes on Deep-Level Winding," by Mr. J. A. Vaughan. This considers shafts 4,000 ft. or more deep and gives some particulars of the equipment installed at some South African mines.

"Recent Progress in Engineering Production," by C. M. Linley. Pp. xiii+340; figs. 303. London: Ernest Benn, Ltd. Price 42s. net.

Scientific Paper of the United States Bureau of Standards, No. 490, "Spectra and Critical Potentials of Fifth Group Elements." (24 pp.) Washington: Government Printing Office. Price 10 cents.

A Spanish Electrical Exhibition.—A wireless, kinematographic and electrical exhibition is to be held at Madrid from December 6th to 25th. Practical demonstrations will form a feature of the show.

The Australian Tariff Changes.—The Federation of British Industries recently drew up a memorandum for presentation to the Australian Government protesting against certain proposed changes under the Australian Preferential Tariff which, as they stand, will operate severely to the detriment of certain British industries, though it is not believed that the framers of the Regulations so intended. The points raised bear upon the percentage of factory or works cost of goods that is derived from material of United Kingdom origin and/or labour performed in the United Kingdom. Special consideration, it is suggested, should be given in certain cases, and the Federation asks in the Memorandum for an assurance from the Australian Government that before the new regulations come into force the various industries in the Federation will be allowed to submit reasoned statements of any hardships likely to be caused by the change in conditions.

Tide Utilisation.—In connection with the project for the establishment of a plant to utilise the power of the tides in the Aber Vrac'h estuary, in the French department of Finistère, of which some particulars were given in a recent issue of the REVIEW, we learn that a company has been formed in Paris, with the title of La Société de la Houille Bleu, to carry through the scheme. The public has been invited to subscribe capital to the extent of 34 million francs in 500 fr. shares and 18 million francs in debentures. Under agreement, dividends on the preference shares will be paid out of funds provided by the French Government during the construction of the plant.

Local Exhibitions.—The last of the series of exhibitions arranged by the SHROPSHIRE, WORCESTERSHIRE & STAFFORDSHIRE ELECTRIC POWER CO. in a number of towns in its area was held at Redditch recently. A number of the larger electrical firms and local contractors participated and the show attracted many visitors and inquiries.

Correction.—In the advertisement of the WESTERN ELECTRIC CO., LTD., appearing on page 61 of our Advertisement Supplement last week, the telephone exchange and number were incorrectly given. The number is: "Central 7345," 9 lines.

Irish Free State Electrical Imports.—The imports of electrical machinery, apparatus and accessories into the Irish Free State during August last attained a value of only £29,337—as compared with £33,095 in the preceding month—bringing the total for the first eight months of the year to £311,831. The appended table shows the details of the imports and the amount attributed to Great Britain and Northern Ireland. It is pointed out in the official returns that the values show the quantity of goods consigned from the countries mentioned, and that it does not follow that they are all of British manufacture. Of the balance of £19,685 from foreign countries £7,968 is attributed to Germany and £5,416 to Belgium.

	Total Aug., 1924.	Eight Months, 1924. Total.	U.K. Share.
	£	£	£
Electric wires and cables ...	5,670	49,592	33,857
Telegraph and telephone instruments	1,931	22,942	22,817
Electric lamps and parts ...	2,431	12,153	11,062
Batteries and accumulators	1,279	13,601	12,888
Electric lighting accessories and fittings	2,977	18,443	17,637
Radio sets and apparatus ...	2,842	75,984	74,511
Other electrical goods and apparatus	6,716	75,206	71,949
Electric generators	653	6,312	6,174
Electric motors	1,073	11,685	11,149
Other electrical machinery ...	3,765	25,913	25,102
Totals	£29,337	£311,831	£292,146

Aluminium Scarcity in France.—It is reported that a scarcity of aluminium is prevalent in France at the present time. An inquiry into the question made in consuming (foundry) circles by a representative of the *Journée Industrielle* has elicited a statement to the effect that the French production of aluminium is limited and much less than the demand experienced in the inland market. The aluminium foundries at present are loaded with orders, but owing to the insufficiency of the supply they will no doubt be compelled to refuse fresh orders and even have to consider the question of working short time or of discharging some of their workmen. As to the problem of procuring aluminium from abroad, the correspondent was informed that this has been thought of, but the metal is subject to a high import duty which is almost equal to the price of raw aluminium in France. The foundries demand the abolition or reduction of the import duty. M. Georges Vesier, president of the Chambre Syndicale des Metaux, is reported to have said that the tariff which is applied to countries capable of exporting aluminium to France is the minimum tariff. In 1922-23 the stocks of crude aluminium were considerable both in France and abroad, and makers were in a difficult situation from this fact. Since then, however, the world's consumption has greatly increased, so that the stocks have disappeared and a scarcity of aluminium is manifested both in France and in other countries. As far as French producers are concerned, M. Vesier said that after a winter in the course of which the waterfalls have yielded little power, the makers are at present burdened with orders. To meet the situation, French producers have not failed to make important sacrifices so as to provide new installations with the object of meeting all requirements. However, these installations, notably new hydraulic works, cannot be carried out as rapidly as could be wished. M. Vesier said that the suppression of the import duty would be a grave and inopportune measure, which would strike a hard blow at French producers at the moment when they were making a considerable financial effort, and would involve the risk of arresting the great progress which the French aluminium industry has made.

Swedish Telephone Industry.—*Swedish Export* (the organ of the General Export Association of Sweden) attributes to Mr. Hemming Johansson, the managing director of the L. M. Ericsson Company, statements regarding the outlook for the telephone industry in Sweden. Reference is made to the plans of the Swedish Telegraphs to continue the conversion of the Stockholm telephone system into an automatic service. As it is, the Ericsson works are employed to about two thirds of their capacity, and the cable works fully. The proportion of the output going abroad is about two-thirds of the total, and the company has at present in hand contracts for automatic exchanges in Rotterdam, Verona, and Mexica City, exchanges and networks in San Sebastian and other places. The number of workers at the telephone works has been about 1,100 since the beginning of the year. The order stock of the British L. M. Ericsson Co. has increased more than 50 per cent., and the number of workers has increased to 1,750 from 1,370 at the beginning of the year. The French company is also doing better having received several large orders from the French Government.

Important Wage Decisions.—Meetings of two of the National Councils for electrical industries were to be held this week. Yesterday the report of the Special Tribunal for the consideration of wages and conditions in the tramway industry was to come before the National Council of that industry. To-day (Friday) the National Council for the Electricity Supply Industry is considering the recommendations made by another tribunal with regard to power station employés' wages. The two matters concern over 80,000 workers.

Canada's Electrical Trade with South Africa.—During 1923 the imports of electrical material from Canada into the Union of South Africa amounted to £7,029, as compared with £1,082 in 1922.—*British & South African Export Gazette.*

Lead.—In their report dated November 8th, Messrs. James Forster & Co. state:—"We have now had an advance of £6 a ton since the beginning of October and it is only natural to expect a set-back. It remains to be seen whether the fall in prices yesterday will bring out re-selling orders from speculators or from the Continent. Supplies are coming in more slowly than in the past, but there is also more lead on offer for forward delivery. Germany continues to buy and inquire for lead, but it is noticeable that the demand there is slackening, no doubt owing to the high price. Home consumers are buying steadily, but only for near delivery."

Trade Union Regulations and Output: Prize Competition.—Under the Peter Le Neve Foster Trust the Council of the Royal Society of Arts offers a prize of £25 for an essay on "The Effect of Trade Union Regulations on Industrial Output." Intending competitors must send in their essays not later than March 31st, 1925, to the Secretary, John Street, Adelphi, London, W.C.2.

Taxation and Industry.—Before Lord Colwyn's Committee on the National Debt and the Incidence of Existing Taxation, Sir James Martin gave evidence on November 4th on behalf of the Association of British Chambers of Commerce. In the course of his statement, according to *The Times* report, Sir James said that it was the general view of commercial men that the effect of high taxation was to deprive them of a good deal of the surplus which could otherwise be used for business development, and that it limited the power of the community to extend enterprise either at home or abroad. This was especially felt where businesses were making profits below the normal, and paying annually, under the three years' average, large sums for income tax. As compared with pre-war days, increased capital was required to carry on the same amount of business owing to the increase in prices, and it was also needed to develop new industrial methods to meet the needs of the increasing population. Taxation could be reduced in several ways—namely, by Government economy; by the continuance of conversion operations as national credit improved; by trade expansion, which would increase assessable incomes; and by a settlement of Allied indebtedness on a fair basis. In the opinion of some Chambers, the burden of taxation added to the cost of business through increased charges for salaries, and it diminished the fund available for depreciation and wasting assets which business men had to provide in excess of the Inland Revenue allowances. In the view of others, while income tax did not technically enter into cost, it affected prices, and this handicapped the exporter when it forced the selling price of a manufactured article, allowing for a reasonable profit, to a higher level than that of similar foreign goods. In effect the trader frequently took into account, indirectly, the income tax he would have to pay and fixed his prices at such a level as would yield the minimum net income he desired to obtain or actually needed.

Calculating Lamp Discounts.—The WHITWORTH ELECTRIC LAMP CO., LTD., has issued a series of tables, by means of which the discounts allowed by the E.L.M.A. to re-sellers can be calculated, thus saving much time in the checking of invoices.

Unemployment.—The number of registered persons again decreased during the week ended October 27th, falling from 1,204,078 to 1,203,100. The decrease was thus 978 for the week and 83,523 since December 31st, 1923.

Committee on Industry and Trade.—The *Board of Trade Journal* states that the third meeting of the Committee on Industry and Trade was held on November 3rd. Unfortunately, the witness whose evidence was to be taken was prevented from attending, and his evidence was therefore to be taken at the next meeting, on November 12th. As the Committee considers that much of the material with which it has been furnished by Government Departments would be of immediate interest and value to those interested in British trade and industry, it is considering the possibility of publishing selections from it by instalments during the currency of its work. It is felt that this course would be preferable to holding back the publication of the material until the work of the Committee is finished. The various divisions of the Committee's work were fully reviewed in the course of the meeting, and satisfactory progress was reported.

Industrial Welfare.—Speaking at the annual general meeting of the Industrial Welfare Society on November 7th, the Duke of York (president) said that the past year with its unsettlement had compelled the Society to curtail its activities, but he hoped that this unfortunate phase was merely temporary and would pass with the revival of trade.

Lord Invernairn (chairman) said that in spite of the drastic curtailment of activities, the Society found itself in a good financial position. The work which the Society was doing made no sentimental appeal, but to those who were able to visualise its work and its results in industry throughout the country, nothing in the present stage of our country's development was more important or fraught with greater possibilities for happiness and stability.

Switchgear at Melbourne Exhibition.—The Electric Equipment Manufacturers' Pty., Ltd., South Melbourne, has sent us a description of its exhibit at the All-Australian Exhibition, which was held in Melbourne from September 13th to November 8th. The firm showed a range of oil switches from a non-automatic type for low voltage up to a heavy-duty type with a momentary breaking capacity of 130,000 h.p. A complete sub-station panel, with an oil switch, current transformers, isolating switches, protective relays and switches, was shown in operation. A great deal of other switchgear was also shown, including a 66,000-V switch as used for large outdoor sub-stations. The makers state that the exhibit was of interest as being the production of the only firm actually designing and making e.h.p. switchgear in Australia.

A Recent Contract.—The Crown Agents for the Colonies have placed an order for 24,000 tons of steel rails and sleepers for Uganda railway extensions with Messrs. Bolckow, Vaughan & Co., Ltd., of Middlesbrough.

British Trade with India.—In a report upon the position of British trade with India as at June, 1924, Mr. T. M. Ainscough, Senior Trade Commissioner in India and Ceylon, states that "for the first time after four years of unprecedented depression it is possible to sound a note of guarded optimism." Referring to the determination to purchase Indian goods as far as possible for Government purposes, Mr. Ainscough says that there seems to be little doubt that the new Indian Stores Department will rapidly increase in importance, and that the centre of purchasing influence, so far as imported stores are concerned, will be transferred from London to India. It is Mr. Ainscough's opinion that there is a great deal of purchasing power latent in India.

Lighting and Power Notes.

Australia.—BALLARAT (VIC.)—The Electric Supply Co., of Victoria, Ltd., is to install additional plant at its electricity works in the town and is considering the question of extending its mains to outlying districts. The estimated cost of the plant is £40,000. A similar outlay is to be made on the company's undertaking at Bendigo.

COROWA (N.S.W.).—The Town Council is changing over its system of supply from 240-V d.c. to a.c. 3-phase 400/230 V, in order to take a bulk supply from the Victorian Electricity Commission. According to the *Electrical Engineer of Australia and New Zealand*, the terms from January 1st, 1926, are as follows:—£19 per kW of maximum demand, plus .4d. per kWh, the latter charge to be eliminated as from January 1st, 1928. Energy will be transmitted at a pressure of 6,600 V.

NEW SOUTH WALES.—According to the *Industrial Australian and Mining Standard*, the New South Wales Railway Commissioners have formulated proposals regarding a power development scheme involving the expenditure of £6,000,000. It is understood that the scheme provides for the supply of electricity to municipal councils all over the State. The construction of a western power station to supply the needs of western districts, and the erection of a power station near Lithgow, are also being considered.

Bath.—ELECTRICITY EXTENSIONS.—The Town Council has received the sanction of the Electricity Commissioners to loans for the supply of electricity to West Wilts., and for extensions at the Dorchester Street works.

Birkenhead.—ELECTRICITY AGREEMENT.—The Electricity and Tramways Committees have reached an agreement whereby the Town Council is recommended to approve of the South End generating station being transferred to the Electricity Committee for the sum of £2,500. The station was the property of the Tramways Department.

Broadstairs.—ELECTRICITY CHARGES.—The Isle of Thanet Electric Supply Co., Ltd., has informed the Urban District Council that application has been made for authority to increase the charge for electricity from 6d. to 8d. per kWh. The Council does not propose to object to the application.

Continental.—BELGIUM.—The recent inauguration of the Bressoux plant brings the number of power stations operated by the Société Intercommunale Belge d'Electricité, of Brussels, up to eight, with a total capacity of 107,400 kW, an increase of 23,150 kW during the 12 months. In view of the increasing demand, it has been decided to put further extensions in hand in order to increase the capacity to a total of 150,000 kW, and two new 13,600-kVA turbo-alternators are to be installed at the Roux station. At the Paturages station, although this is now linked up with the plant at

Monceau-sur-Sambre by a 50,000-V transmission line, a further generating set of 8,200 kVA is to be installed. At the Monceau station a third 15,500-kVA turbo-alternator has lately been put in operation, and a fourth set of 16,700 kVA is being erected. At the Malines station two new boilers, a fifth turbo-alternator of 15,500 kVA, and a 50,000-V transformer plant are being added, the last being intended to link up the station with that at Alost. At the Sweveghem station a fifth generating set of 11,500 kVA is being installed, and one of a similar capacity is in course of erection at the Alost station. Since the starting in July last of the Bressoux station, which is supplying current to the mains of the Société de l'Electricité de l'Est de la Belgique, by means of a 50,000-V transmission line, the station at Verviers has been utilised as a reserve plant in case of a breakdown at Bressoux.

SWITZERLAND.—Plans have been prepared for the establishment of two large power stations to utilise available waterpower in the Waggital to supply energy to Zurich and to North-East Switzerland. The water will be utilised in two stages—one in a station at Rempen under a head of 846 ft. and the other at Siebnen, working with a 646-ft. head. The first-named plant will be equipped with four sets of 18,000-h.p. turbo-generators, and that at Siebnen with four 16,000-h.p. sets.

FRANCE.—Considerable progress has been made with the establishment of a plant to utilise the power of the Baton falls in the valley of Romanche, near Grenoble, for generating electricity. One generating set of 3,300 h.p. has already been installed, the energy being supplied to the town of Grenoble.

ROUMANIA.—A report recently issued states that there are at present 81 power stations in operation in Roumania, of which 26 are operated by water-power, 25 by steam engines, and 30 by internal-combustion engines. Direct current is generated at 35 stations, single-phase at four, two-phase at two, and polyphase at 40 of the plants.

Cornforth.—STREET LIGHTING.—The Electricity Commissioners have sanctioned the borrowing of £1,989 for the purpose of lighting Cornforth Lane, Old Cornforth, and West Cornforth streets by electricity instead of gas.

Gloucestershire. — PROPOSED ELECTRICITY SCHEME. — The Gloucester and Cheltenham Corporations have received an intimation from the Electricity Commissioners to the effect that extensions to the present plant of their electricity undertakings are not advisable and suggesting that the two towns should either obtain a bulk supply or that the Corporations should agree to erect a power station to supply both towns. The chairman of the Cheltenham Electricity Committee states that the offer of the West Gloucestershire Power Co., to provide a bulk supply is unfavourable and informal consultations have taken place between the two Electricity Committees in which it was agreed that a suitable site for a power station is available in Gloucester. Mr. Corson, the electrical engineer to the Gloucester Corporation, has prepared plans and estimates for such a power station which it is estimated would cost £200,000.

Hebden Bridge.—EXTENSION OF SUPPLY.—The Electricity Committee has decided to lay a cable to Eaves Estate, where the Council proposes to erect houses, plans for which have been approved.

Heston and Isleworth.—ELECTRICITY IN BULK.—The Electricity Committee has recommended to the Urban District Council that an agreement be entered into with the Twickenham and Teddington Electric Supply Co., Ltd., for a bulk supply of electricity to the company at a charge of 3½d. per kWh.

Horley.—SPECIAL ORDER.—The Horley and District Electricity Supply Co., Ltd., has applied to the Electricity Commissioners for a Special Order authorising it to supply electricity in the district, and to a portion of the parish of Charlwood.

Ilford.—ELECTRICITY IN BULK.—The Urban District Council is negotiating with the County of London Electric Supply Co., with a view to obtaining a bulk supply of electricity. A bulk supply from West Ham was commenced this week.

India.—PAPANASAM HYDRO-ELECTRIC SCHEME.—According to *Indian Engineering* it is understood that the Government of Madras proposes to start at an early date the investigation of the Papanasam hydro-electric scheme in the Tinnevelly district with a view to co-operating with the Forest Department in an extensive scheme of industrial development and the supply of power for industries and domestic purposes in that area.

Leyland.—SPECIAL ORDER.—The Lancashire Electric Power Co., has applied to the Electricity Commissioners for a Special Order, authorising it to supply electricity in the urban district.

London.—STEPNEY.—The Electricity Committee has submitted the following recommendations to the Borough Council:—(1) That a new set of 3,000-kW capacity be installed at Limehouse generating station, at an estimated cost of £20,000, to replace a 2,000-kW turbo-alternator at present in use, and that the latter set be disposed of for a sum of £5,340. (2) That turbines Nos. 5 and 6 be scrapped and disposed of for a sum of £11,510, and two new turbines installed, with switchgear, capable of operating at a steam temperature of 700 deg. F., at an estimated cost of £25,000, the alternators and condensing plant of sets Nos. 5 and 6 being retained. (3) That application be made to the Electricity Commissioners for sanction to increase the capacity of the power station by 1,000 kW, and to the borrowing of £28,150 to carry out the improvements.

New Zealand.—MANGAHAO HYDRO-ELECTRIC SCHEME.—According to a *Reuter* message from Wellington, the Mangahao hydro-electric works was formally inaugurated by Mr. Massey, the New Zealand Prime Minister, on November 3rd.

TAURANGA.—The ratepayers have sanctioned a proposal of the Tauranga Electric Power Board to raise a loan of £100,000 for the supply of electricity in the county. The *Industrial Australian and Mining Standard* states that the Board has completed an arrangement under which energy will be purchased in bulk from the Tauranga Borough Council. A supply will be given from the McLaren Falls power station which it is anticipated will be in operation in April next.

Northern Ireland.—NEWCASTLE (CO. DOWN).—The Urban District Council has entered into an agreement with the Irish Towns Electric Lighting Co., for the lighting of the town for a period of three years at a charge of £287 per annum.

CASTLEBLANEY (CO. MONAGHAN).—The Urban District Council has approved an electricity scheme submitted by Mr. P. Marron, who has been given wayleaves for the erection of overhead lines.

Paisley.—YEAR'S WORKING.—The accounts of the Corporation electricity undertaking (engineer, Mr. W. Blair Smith) for the year ended May 15th last, record a total revenue of £89,836, as compared with £79,942 in 1922-23. The working expenses amounted to £51,206, as against £44,362, leaving a gross profit of £38,630 (£35,380). After payment of interest and sinking fund charges there remained a net profit of £7,298, the whole of which was placed to reserve. In the previous year there was a profit of £2,511. The capital expenditure during the year was £19,515, of which mains accounted for £12,015. The sales of electrical energy increased from 7,944,402 to 9,236,623 kWh, and the maximum supply demanded rose from 4,450 to 5,000 kW. During the year an agreement was entered into with the combined authorities of the Greenock Corporation, the Ayrshire Electricity Board, and the Clyde Valley Power Co., for a bulk supply up to 8,000 kW. The work of completing the 6,600-V, 3-phase, e.h.p. ring main was commenced, and much progress was made during the year.

Price Reductions.—Reductions in the charges for electricity have been made or recommended in the following districts:—

STOCKPORT.—Lighting: First 20 kWh per quarter, 6d. per kWh, beyond 4¾d. per kWh, with a minimum charge of 40s. per annum.

MAIDSTONE.—Lighting: Flat rate for business premises from 8d. to 7¼d. per kWh; private houses, from 6¼d. to 6d. per kWh. Contract demand rate, from 18s. to 17s. per 30-watt lamp per annum. The initial charge on the "telephone" system from 9s. to 8s. per 30-watt lamp per annum.

ARBROATH.—*The Arbroath Electric Light & Power Co., Ltd.*—Lighting: From 7¼d. to 7d. per kWh. Heating: From 3½d. to 3d. per kWh. A reduction has also been made in the charge for power purposes.

Reigate. — LOANS. — The Town Council has applied to the Electricity Commissioners for sanction to loans of £2,000 for mains and services, and £4,350 additional cost incurred by the modified plant extensions scheme.

South Africa.—THE MULUNGUSHI FALLS SCHEME.—The *S.A. Mining and Engineering Journal* reports that the machinery and equipment for this undertaking is being delivered and it is expected that the first portion of the plant will be put into commission next year. The plant will consist of a 3,150-h.p. Pelton wheel driving a 2,000-kW, 2,000-V, 3-phase generator. The current will be stepped up to 44,000-V for transmission to the zinc and lead mine of the Rhodesian Broken Hill Development Co., where it will be reduced to its original pressure. At the mine new equipment consisting of a concentrating and de-sulphurising plant and an electrolytic zinc-producing plant has been installed. The capacity of the new concentrating plant is stated to be 300 tons of ore per day, estimated to produce 110 tons of zinc concentrates and 60 tons of lead concentrates. At a later date additional plant will be installed and the capacity of the Mulungushi hydro-electric station will be increased to 10,000 h.p.

Special Orders.—The Electricity Commissioners have submitted the following Special Orders made by them to the Minister of Transport for confirmation:—Kenfig Hill and district to the Penybont Rural District Council; Guisborough to the Urban District Council of Guisborough; Blandford Forum to the Blandford Forum and District Electric Supply Co.; Woldingham and district to the Urban Electric Supply Co., Ltd.

Torquay.—LOANS SANCTIONED.—The Town Council has received from the Electricity Commissioners sanction to loans of £5,000 for mains and services, and £3,000 for meters.

Electricity Supply in Cape Town.

The Dock Road Power Station.

THE history of electricity supply in Cape Town, the "Mother City of South Africa," commenced in 1895, when a small generating station was set in operation; this soon proved inadequate to cope with the rapidly growing demand, and it was decided to erect a new station in Dock Road, temporary plant being installed in an iron shed in 1900 to carry on until the permanent station was opened. This was done in the year 1904. The system of supply that was originally employed was d.c., 5-wire, but in 1897 it was converted to 3-wire at 220-440 volts.

High - pressure a.c. transmission on the two-phase system was introduced in 1909, to supply the suburb of Sea Point, which was incorporated with the city in 1913, and in 1911 the Corporation acquired the undertaking of the Cape Peninsula Lighting Co., which served some of the adjoining townships; further extensions of plant thus became necessary, and in 1913 steam turbo-alternators were installed at Dock Road. Since that date the capacity of the plant has been increased from time to time, and now stands at 16,900 kW. According to the "Official South African Municipal Year Book (1924-25)," to which we are indebted for some of the particulars here given, in 1922 the capital invested in the undertaking, less depreciation, stood at £880,677; the total annual revenue was £311,178, and the working expenses £157,027. After deduction of capital charges there remained a surplus of £25,700, which was allocated to the relief of the rates. The chief electrical engineer is Mr. G. H. Swingler, M.I.E.E., to whose courtesy we are indebted for the photographs which are here reproduced. Under his supervision the system is being changed over to three-phase four-wire supply, at 220-380 volts. The area supplied amounts to about 30 sq. miles, the furthest point being 20 miles from the power station; there are over 15,000 consumers, and 4,300 street lamps.

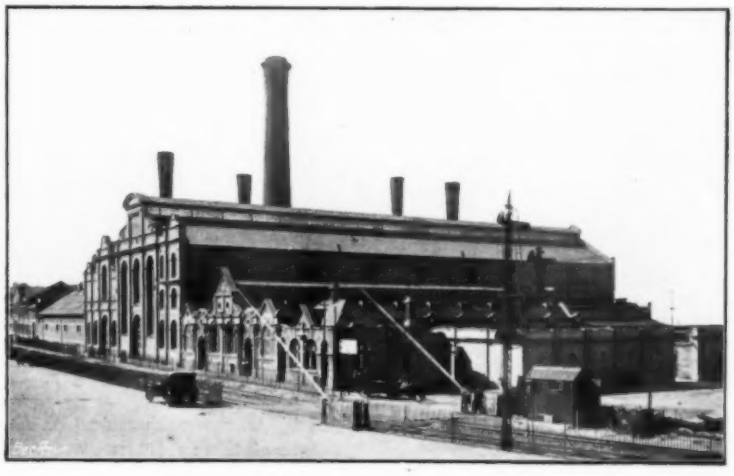


Fig. 1.—Dock Road Power Station, Cape Town.

Fig. 1 is a view of the power station from Dock Road, and fig. 3 shows the interior of the engine room in 1924; space is available for an additional turbo-generator.

The boiler-house, fig. 2, contains two boilers of 17,500 lb. per hour steaming capacity, and four rated at 35,000 lb. These are all of the Babcock & Wilcox "marine" type, arranged for use on land, and work at 220 lb. per sq. inch; they are fitted with double chain-grate stokers of the B. & W. "Compartment" type, and the makers' traversing coal shoot arrangement. Forced and induced draught fans, with suitable chimneys, and the "Diamond" soot blower have been supplied by Messrs. Babcock & Wilcox. The boilers are provided with integral superheaters to give a superheat of 150 deg. F., and economisers are fixed above them. Space is available in the boiler house for two additional boilers of 32,000-lb. rating.

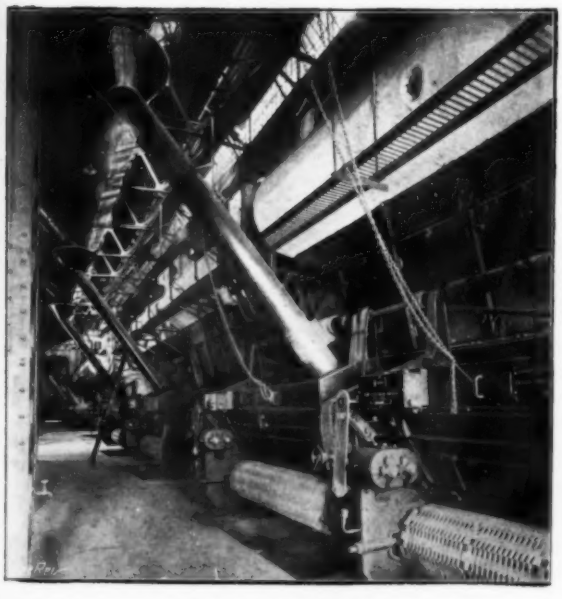


Fig. 2.—Boiler House.

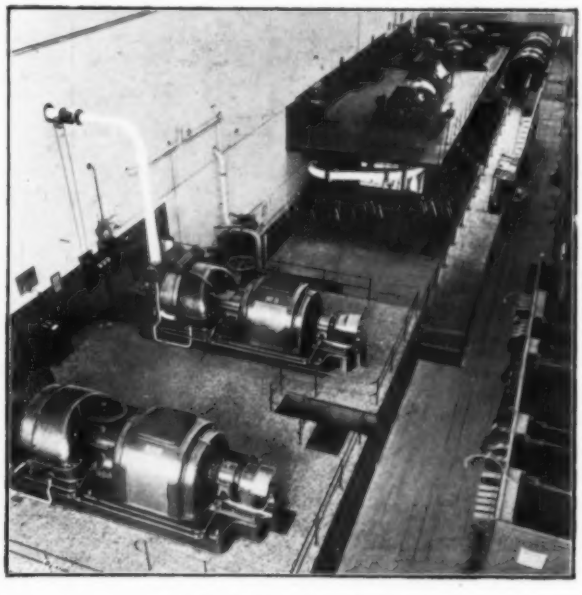


Fig. 3.—Interior of Engine Room.

Fig. 4 is a view of a set manufactured and recently installed by the Metropolitan-Vickers Electrical Co., Ltd., Manchester; it consists of a turbo-generator having a maximum continuous rating of 7,500 kW, and

designed for the most economical operation when developing an output of 6,000 kW. The alternator is wound for 11,500 volts, three-phase.

The conditions under which the turbine is operating are 165 lb. per sq. in. steam pressure, and 150 deg. F. superheat. Provision is made for working under improved conditions at a later date.

The turbine exhausts into a Metropolitan-Vickers condenser having a cooling surface of 12,000 sq. ft. Cooling water is obtained from Table Bay, and the condenser is fitted with ¾-in. tubes of 18 B.W.G., made of Admiralty mixture. As a further precaution against electrolytic action, the Cumberland electrolytic apparatus has been installed.

The condenser auxiliaries include a Leblanc type rotary air pump, a centrifugal water extraction pump, and a rotary lift pump, all three driven by a motor supplied from the 2-phase system.

The alternator is ventilated on the closed-air system, incorporating an M-V air cooler, and is connected to the system through three oil-immersed surface-cooled ironclad reactances, arranged to form a 3-phase group.

In the engine room there are two 3,000-kW and two 1,700-kW impulse turbo-alternators, built by the British Thomson-Houston Co., Ltd., Rugby. The alternators of these machines are wound for 2,300 volts, 50 cycles, two-phase.

The main switchgear and control board, illustrated in figs. 5 and 6, was supplied by the British Thomson-Houston Co., Ltd. The auxiliary plant includes four Bruce Peebles motor-converters, of 1,000 kW each, and a 900-Ah Chloride storage battery.

Fig 7 is a view of the static sub-station at Muizenberg, and fig. 8 shows the interior, equipped with Reyrolle ironclad switchgear, that on the left controlling the 11,000-volt feeders, and that on the right the 3,300-volt distributors.

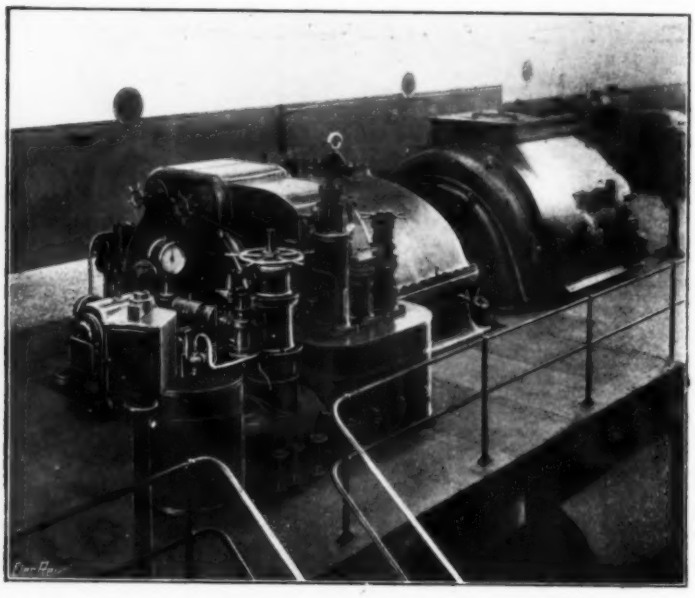


Fig. 4.—Metropolitan-Vickers 7,500-kW Turbo-Alternator.

Fig. 5.—Control Board.

Fig. 6.—B.T.-H. High-pressure Switchgear.

Fig. 7.—Muizenberg Sub-station.

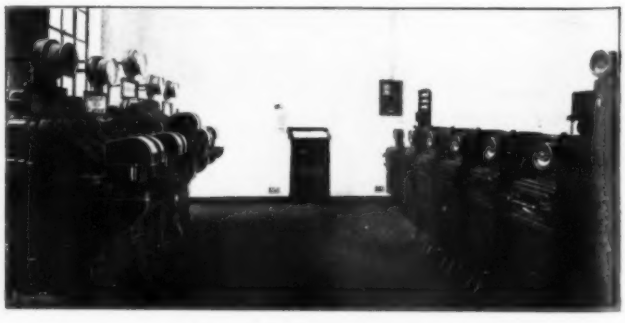


Fig. 8.—Reyrolle Switchgear in Sub-station.

Electricity Supply at St. Pancras, London.

Inauguration of New Plant.

THE St. Pancras Borough Council was the first public authority within the Metropolis to undertake the important function of supplying electricity. In November, 1891, electricity was supplied to the public at 110 and 220 volts from the Regent's Park generating station; in 1894 a second station, designed to supply on the five-wire system, was built in King's Road under the direction of Prof. Robinson. The chief electrical engineer (Mr. Sydney W. Baynes), however, in 1896 raised the pressure to 220 and 440 volts on the 3-wire system. In 1894, 1896, and 1900 further generating plant was added, and in 1903 three-phase transmission to sub-stations placed at remote parts of the borough was inaugurated, St. Pancras being again the pioneer local authority to introduce the 5,000-volt, 50-period alternating system.

In 1905 and 1906 Parsons turbines were installed, but in 1912 the then chairman of the Electricity Committee accompanied an alderman and the chief electrical engineer to Stockholm in order to test the Ljungström turbine, which was at that time being introduced to the electrical world. The result was an order placed with the Brush Electrical Engineering Co., Ltd., of Loughborough, to provide at the King's Road works a 1,500-kW Ljungström turbo-generator; it came into use in 1914, being the first manufactured in this country. Additional boilers were installed, but the war intervened, and consequently half the contemplated boiler-house was abandoned; likewise new engine-room extensions, which had been commenced, were stopped.

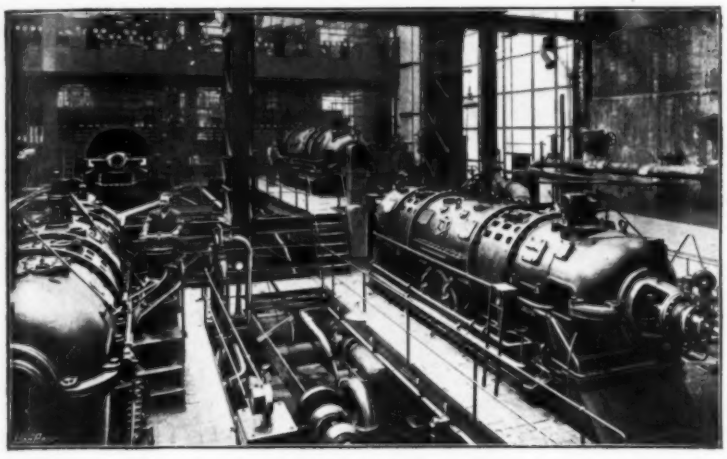


Fig. 1.—Two 3,000-kW Brush-Ljungstrom Turbo Sets.

During 1919 and 1921 two more Ljungström turbines of 3,000 kilowatts were ordered from the Brush Electrical Engineering Co., Ltd. (fig. 1 is a view of these machines, with the new larger sets in the background and the switchboard galleries beyond), and two 7,000-kW sets have since been installed. One of them (fig. 2) was started for service on October 31st, 1924, by the Mayor, the visitors being afterwards entertained to luncheon, during which the electrical engineer (Mr. S. W. Baynes, M.I.E.E.), the Mayor (Coun. R. F. W. Fincham), and the chairman of the Electricity Committee (Ald. J. H. Mitchell) were each presented with a silver salver on behalf of the contractors as a memento of the occasion.

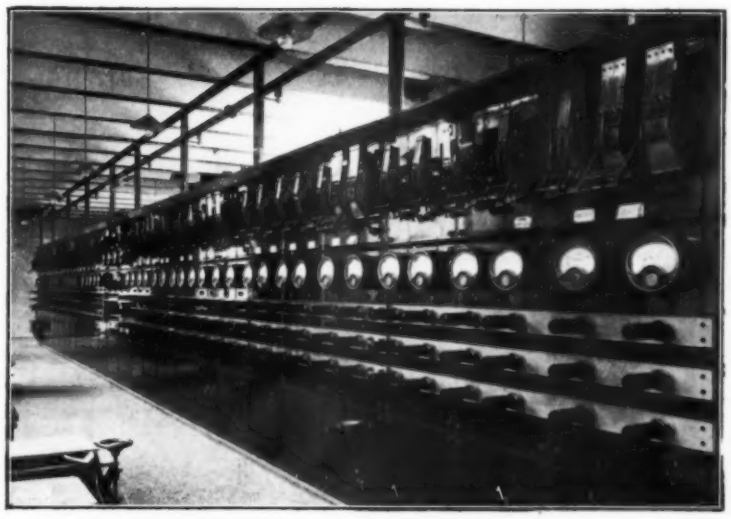


Fig. 3.—The Statter D.C. Switchboard.

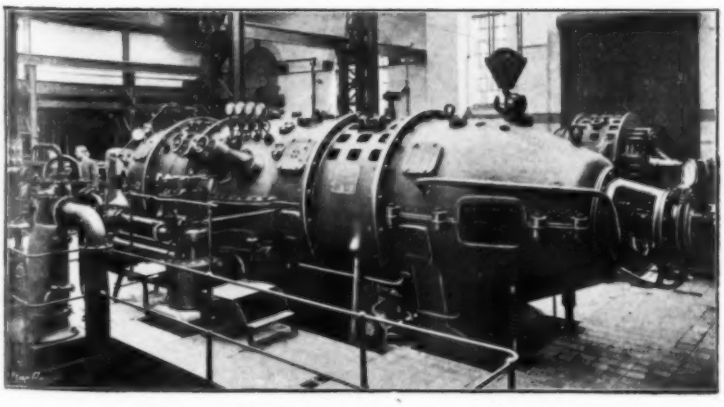


Fig. 2.—A 7,000-kW Brush-Ljungstrom Turbo-Generator.

The 7,000-kW, 3-phase machine generates at a pressure of from 5,050 to 5,300 volts, 50 periods, 0.9 power factor, with a vacuum of 28.5 in. at the exhaust flange and steam at a pressure of 190 lb. per sq. in. at the turbine stop valve, superheated to 200 deg. F. The surface condenser has a cooling surface of 12,000 sq. ft., and is designed to maintain the specified vacuum when supplied with 8,600 gallons of water per hour at a temperature not exceeding 70 deg. F.

The air and water are extracted from the condenser by means of a Hick-Breguet steam ejector and water extraction pump. The ejector is capable of extracting 41 lb. of air per hour from the condenser, and the water pump is driven by an 8½-h.p. Brush d.c. motor and delivers the condensate against a total external head of from 36 to 40 ft. into a closed feed system. The steam from the secondary nozzle of the ejector is led to a feed-water heater through which the main condensate is passed; a large portion of the heat in the steam supply to the jets is therefore recovered. The cooling air for the alternators is drawn through a "Sirocco" washer, capable of dealing with 20,000 cu. ft. of air per minute.

The second 7,000-kW set is in course of erection, and is a duplicate, with the exception that a Brush-Delas air ejector and a "Pulsometer" water extraction pump are being provided.

Fig. 4.—Reyrolle High-Pressure Switchgear.

A motor-generator set has been supplied by the Brush Electrical Engineering Co., Ltd., to be used as a stand-by for separate excitation for either of the 7,000-kW or the 3,000-kW sets. It is designed to run at a speed of from 1,100 to 1,220 r.p.m.; the motor is rated at 82 h.p., and the generator develops an output of 55 kW, with a pressure of 25 volts at 0/500 amps. The latter conditions have been provided so that the motor-generator set can be used for battery charging when it is not in use for excitation purposes. The demand for electricity is such that the Council has decided to install a further turbo-generator, which is to be of 10,000-kW capacity.

The King's Road generating station is equipped with two Bruce Peebles 1,000-kW motor converters, and three 1,500-kW converters are being installed. Three galleries house the switchgear and are sheltered from the engine-room behind a glass partition. It also became necessary to reconstruct the whole of the switchgear, and the contract was secured by Messrs. A. Reyrolle & Co., Ltd., for high-pressure gear of the totally-enclosed type, the whole being electrically operated from remote controlling panels (fig. 5). The speed of each turbo-generator is also controlled electrically from the switchboard; automatic regulators take charge of each set, maintaining the electrical pressure within 1 per cent. of standard. Having in mind the possibility of a higher standard pressure of transmission becoming essential when the reorganisation now under consideration by the Electricity Commissioners comes into force, this switchgear (fig. 4) has been provided for a working pressure of 12,000 volts (11,000 volts being the figure contemplated as the standard from the sub-stations of the super-stations to local stations), and the present gear has been subjected to a test pressure of 20,000 volts. This is a good example of how this type of gear can be installed in restricted space. Messrs. J. G. Statter & Co., of London, secured the contract for the low-pressure switchgear (fig. 3) covering the 220- and 440-volt local distributing system.

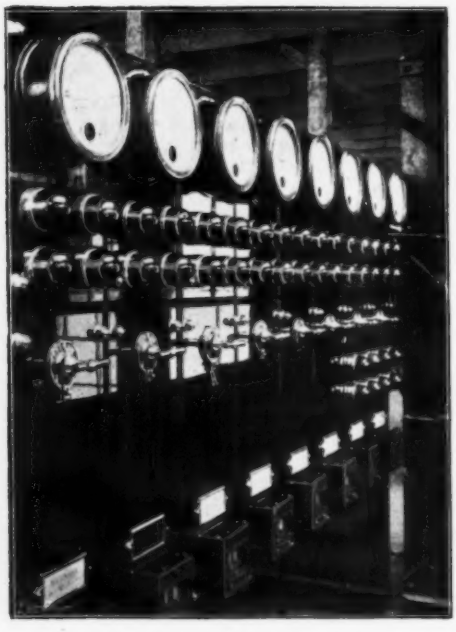


Fig. 5.—Part of the Reyrolle Control Board.

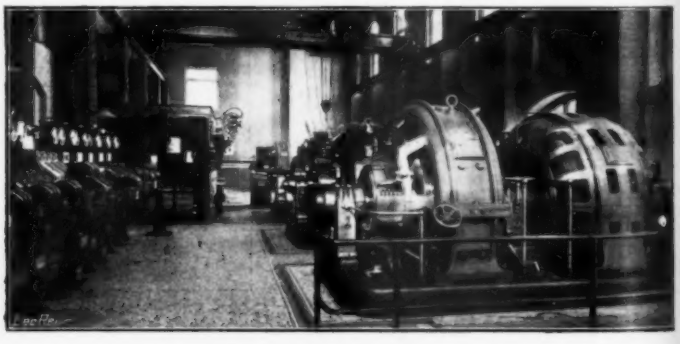


Fig. 6.—Tavistock Place Sub-station.

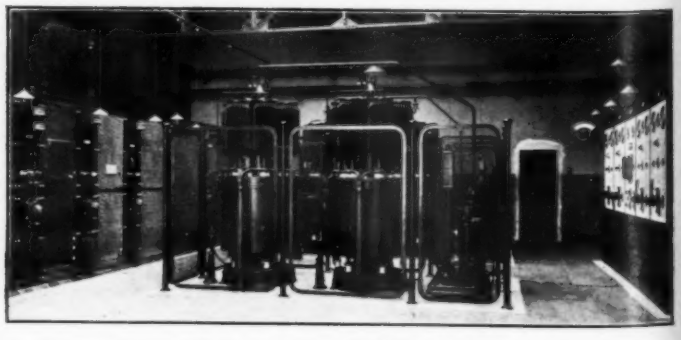


Fig. 7.—Mercury Rectifier Sub-station.

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Each of the four existing boilers is mechanically fired and provided with both forced and induced (*i.e.*, balanced) draught; the coal is automatically weighed on its way to the fires. Further boilers, of a nominal evaporation of 40,000 lb. of steam per hour and 60,000 lb. each per hour maximum, at a working pressure of 230 lb. per sq. in., are about to be installed; two are being manufactured by Messrs. Babcock & Wilcox and two by the Vickers-Spearing Boiler Co., Ltd. All four will be provided with the "Lopulco" system of firing with pulverised fuel, the contract for the pulverising plant having been secured by the Underfeed Stoker Co., Ltd., for the first two boilers, and by Messrs. Vickers and International Combustion Engineering, Ltd., acting as sub-contractors, for the second two boilers. Further boiler-house extensions are in hand, and the total capacity of the eight boilers will be 440,000 lb. of steam per hour at 230 lb. working pressure, superheated to 700 deg. F.

A 3-ft. diameter main passes from the pump-house on the canal bank into the works, where circulating water is tapped off to the condenser of each generating set, and returned through a similar pipe to the canal some 150 yards away. Three Rees Roturbo electrically-driven pumps are each capable of delivering 750,000 gallons per hour, one acting as a stand-by, and the water is screened by three automatic revolving screens installed by Messrs. Ledward & Beckett.

The ash-handling plant was fitted by the Underfeed Stoker Co., Ltd. It is of the high-velocity water-flow type, whereby water under the boilers sweeps along a trough all clinker and ashes into a pit, whence it is removed by a 1½-ton grab into a large hopper for cartage removal.

Coal is elevated to the overhead bunkers by an electric traveller, supplied by Messrs. Strachan & Henshaw, Ltd., fitted with a mechanical grab; 1½ tons of coal is taken each journey. A large electric oil lift for handling heavy traffic between the dust and electricity yards to the road level was supplied by Medway's Safety Lift Co., and two electrically-driven 25-ton cranes serve the engine-room.

Two electrically-driven turbine pumps return the feed water to the boilers, and two steam-driven turbine pumps stand in reserve to feed the boilers in times of emergency. The feed make-up water to the boilers is chemically treated to soften it, and all water from the condensate passes through special de-aerating plant before returning to the boilers. Chlorinating plant for chemically treating the circulating water from the canal is provided; this process prevents the formation of vegetable growth in the condensers.

The Tavistock Place sub-station is illustrated in fig. 6, showing the h.p. Reyrolle switchgear and the Bruce Peebles motor-converters (full-load capacity of 5,000 kW) on Prache vibrationless foundations. Fig. 7 shows two 9,000-kW mercury arc rectifiers, with B.T.-H. h.p. switchgear, in the North-West sub-station at Grafton Road. The Northern sub-station in Highgate Road contains Bruce Peebles motor-converters and A.E.G. motor-generators, with Reyrolle h.p. switchgear, and to the 3,000 kW of modern Bruce Peebles motor-converters in the original generating station at Regent's Park a further three 1,500-kW sets are to be installed.

The Borough Council recently decided to reduce the charges for electricity to the pre-war rates, while the one-meter system of charging ¾d. per kWh, plus £16 per kW per annum demanded for domestic purposes (lighting, cooking, heating, hot water, &c.) is considerably below the pre-war figures. On March 31st, 1924, the capital expenditure on the undertaking had reached £974,700, while no less than £219,758 has been contributed towards the relief of the rates. On the same date the number of consumers was 9,277; during the year the maximum demand was 11,494 kW, and 22,731,347 kWh were generated at a total working cost per kWh sold of 1.35d. The energy sold for private supply per head of population amounted to 82.4 kWh per annum.

Tramway and Railway Notes.

Colne.—"ONE-MAN" CAR.—The Tramways Committee is experimenting with a single-deck, one-man-controlled tramcar. The safety devices attached to the car include a folding step actuated by the opening door, a door contact which will prevent the car being started before the door is closed, and a control of the rear door operated from the driver's end of the car.

Continental.—ITALY.—By a decree recently published, in substitution for one passed in 1919, the Italian Government grants important subsidies in aid of the electrification, by private industry, of existing State railways, municipal and other tramway schemes, also of wholly new schemes. The subsidy is up to a rate of 8,000 lire per km., and covers a period of 50 years. No stipulation as to the system of traction to be adopted is made.

SWITZERLAND.—Considerable progress has been made with the electrification of the Swiss Federal State Railway system, a recent report stating that out of the 930 miles to be electrified about 380 miles had been completed by the beginning of August last. From 1907 to the end of 1923 259,300,000 fr. had been expended by the Swiss Government on railway electrification, including 105.3 million fr. for power stations and 21.7 millions for transmission lines. Work is at present in hand on the electrification of the Zurich-Olten, Berne-Olten, Zurich-Winterthur, Zurich-Rapperswil, Lausanne-Vallorbe, Lausanne-Palezieux, and Renens-Geneva sections of the system.

A conference of the Swiss Federal authorities was recently held in Berne, when estimates amounting to 91 million francs were submitted in respect of new railway construction during the coming year, 1925. Included in the programme is a direct connection between the Hauenstein line and the Aarau line, in respect of which a credit of 1,190,000 fr. was agreed to. It was also decided to have fresh estimates prepared for a new line in the Surbtal district, which was first proposed in 1920. Approval was given to a contract with the Bernische Kraftwerk Gesellschaft for the supply of the energy required for the electrified lines in the district and those to be electrified. Estimates for the establishment of sub-stations at Kerzers, Rapperswil, and Piudoux were also approved and a credit of 9,615,000 fr. granted in respect of their construction. It was reported that the single-phase electric locomotives and motor coaches now in use on the Swiss Federal railways, excluding the Seethal line, numbered 227, and that by the end of 1926, 304 would be required.

HUNGARY.—The first short-distance line (from Budapest to Alag) will be opened for traffic shortly, and the line from Bouck to the frontier is now being converted for electric traction.

London.—"ONE-MAN" TRAMCARS.—The London United Tramway Co. is to introduce five single-deck tramcars on its Hanwell and Brentford route, which will be controlled by one man, who will perform the duties of driver and conductor. The cars are to be fitted with special safety devices.

L.C.C. TRAMCAR IMPROVEMENT.—The London County Council is to equip its four-wheeled cars with a device which it is hoped will eliminate swaying.

EXHIBITION TRAFFIC RETURN.—In connection with the British Empire Exhibition, a return of the transport facilities provided by the Metropolitan Railway has now been published. During the past six months the total number of trains run between Baker Street and Wembley Park amounted to 107,250, or an average of 650 daily, and the total number of car-miles run was 18,000,000. The number of passengers carried amounted to 11,500,000 approximately, the record day's traffic between Baker Street and Wembley Park being 230,000 passengers.

Middlesex.—The County Council has approved the terms of settlement with the Metropolitan Electric Tramways, Ltd., for the granting of a new lease for a period of 30 years at a rental of £110,000 per annum.

Wolverhampton.—RAILLESS CARS.—The Town Council has adopted the Tramways Committee's report in connection with the running of railless cars to Dudley.

Telegraph and Telephone Notes.

France.—POLICE WIRELESS.—A high-power wireless transmitting station is to be installed at the Sûreté Générale (French police headquarters), and receiving posts will be established at all important police stations throughout the country. It is hoped by this means that details concerning advice as to the arrest and identification of criminals will be broadcast with great rapidity all over the country.

Italy.—NEW TELEGRAPH LINES.—With a view to improving the telegraph communication between Trieste, Rome, Milan, and Genoa, corresponding to the increase of traffic, the Ministry of Communications sanctioned the erection of a line from Milan to Trieste, of another from Genoa to Trieste,

and of two lines between Rome and Trieste, one being partly overhead and partly underground. The linking of Trento direct with Rome is also provided for. These several lines were recently opened to traffic; a complementary circuit will shortly be constructed to link Fiume, Trieste, Quarnaro, and Milan.

Radio "Beam" Telegraphy.—SENATORE MARCONI'S EXPERIMENTS.—Senatore G. Marconi has returned to London after an absence of about three months, during which time he has been further developing his "beam" system, which he is now able to state will be effective for efficient telegraph service over any distance by day as well as by night.

Sweden.—CABLE CONCESSION.—The Swedish Government has extended until 1935 its present concession to the Great Northern Telegraph Co. for the transmission of cablegrams between Sweden, Finland, Denmark, and England, says *Commerce Reports*. At present this company's cables in Sweden consist of four to Finland, two direct to England, and one two-wire Swedish-Danish cable, of which one wire goes direct to England.

Radio Notes.

Austria.—BROADCASTING VOGUE.—That broadcasting has become popular in Vienna is shown by the fact that the lately-formed Oesterreichische Radio-Verkehrs Aktien Gesellshaft has already a subscribers' roll of 15,000. Influential bodies and individuals took part in the foundation of this institution, comprising the State, the Public Works Credit Institute, the Steyrer Bank at Graz, the Municipality of Vienna, the Oesterreichische Anzeigengesellschaft, the Austrian Telegraph Works, the Ericcson Electric Co., the Kapsch Telegraph and Telephone Works, and the firm of Leopold.

Esthonia.—RADIO REGULATIONS.—Preliminary regulations regarding broadcasting have been passed by the radio committee, subject to the approval of the Minister of Communications. According to *Commerce Reports*, Esthonians must procure a receiving licence, valid for one year, from the Postmaster-General, while foreigners must apply to the Minister of the Interior for a similar licence. The length of the antenna of the receiver must not exceed 50 metres, and private broadcasting sets are forbidden, while the wavelength of receiving sets is limited to a maximum of 700 metres. The regulations specify preference for sets of Esthonian manufacture, the importation of foreign apparatus being permitted only after the consent of the Minister of Communications has been granted.

France.—PYRENEES RADIO STATION.—The first trials of the wireless station erected on the Pic du Midi, in the Pyrenees, near Tarbes, which is said to be the highest station in the world, have been carried out in spite of the fact that the pylons, 30 metres high, which were to have supported the aerial, could not be taken to the summit of the mountain. The station was accordingly opened with a temporary aerial. Great difficulty was experienced in assembling the material, which had to be taken up in sections on the backs of mules. The chief objects of the station are to maintain a permanent liaison with Bagneres and to broadcast weather reports. Hitherto communication with Bagneres has been difficult, as the wires were so often broken by snow and avalanches, and for months at a time the weather experts on the mountain top were cut off from the world.—*Reuter* (Paris).

New Station.—SWANSEA.—The British Broadcasting Co., Ltd., is to inaugurate a new broadcasting station at Swansea on December 12th.

Public Demonstrations. — During the Parliamentary general election numerous demonstrations throughout the country were given at which the election news broadcast from all stations of the B.B.C. was reproduced by loud speakers. One successful demonstration was that organised by Wireless Service, Ltd., at the Ladies' Carlton Club, when over 200 members were present. A "Gecophone" two-valve set, comprising one stage of high-frequency amplification and a detector, was used in conjunction with a two-stage amplifier and three loud speakers. Another was the Albert Hall demonstration organised by the *Daily Mail* and the Marconiphone Co. In addition to transmitting the announcement of guests and the speeches at the Lord Mayor's banquet last Monday, the British Broadcasting Co. broadcast some of the remarks of spectators of the Lord Mayor's procession through the streets earlier in the day.

Peru.—CONCESSION.—A 10-years concession for exclusive broadcasting privileges has been granted by the Government to the Peruvian Broadcasting Co.

United States.—STATIC INTERFERENCE.—In the October *Proceedings* of the Institute of Radio Engineers, Mr. R. H. Marriott, of the Navy Yard, Bremerton, Washington, describes the origin of natural "static" near mountain peaks, and compares its mode of production and character with that produced artificially by the operation of electrical smoke and dust precipitators. Not only is it sometimes difficult, he says, to distinguish one from the other, but that the man-made variety sometimes drowns out nature's "static." Some mountains are believed to be sources of "static," while others act as absorbing shields to both signals and "static." On this basis, a certain point near Ketchikan, in Alaska, was found where "static" was not heard in midsummer, while signals were received from some directions but not from others.

Contracts Open and Closed.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared in our advertisement pages.)*

Open.

Argentina.—BUENOS AIRES.—December 22nd. National Sanitation Works. Two sets of electrically-operated centrifugal pumps.*

December 15th. State Oil Fields Administration. Electrical plant and materials.*

Australia. — MELBOURNE. — Electricity Commission, &c. January 12th, 1925. Switchgear and accessories. (October 24th.)

January 19th. 6,000-V transformers and spares; voltage regulating apparatus. (See this issue.)

December 12th. Victorian Railways. 3-phase, a.c. induction motors, starting apparatus and accessories.*

January 21st. Commonwealth Postmaster-General's Department. Automatic c.b. telephone equipment for the offices of the Minister of Public Works, N.S.W. Twenty-five private automatic branch exchange equipments.

Chile.—SANTIAGO.—Port of Constitucion. Semi-portable steam engines, electric generators, &c.*

Dundee.—November 25th. Harbour Trust. Electrification of new wharf, including sub-station equipment, cables, &c. (November 7th.)

Egypt.—December 2nd. Superintendent of Stores, Egyptian State Railways, Telegraphs and Telephones, Bulaq, Cairo. Supply of incandescent metallic-filament and half-watt lamps. Copies of the specification may be obtained at the Stores Department, Saptia (Cairo), or Gabbary (Alexandria). —*Reuter's Trade Service* (Cairo).

Enfield.—November 21st. Enfield and Edmonton Joint Hospital Board. Electric lighting installation at the Hospital, World's End, Winchmore Hill. (See this issue.)

France.—GRENOBLE.—November 20th. Electrification of the Mure to Gap railway, in two sections. M. l'Ingénieur en chef des Ponts et Chaussées, Grenoble.

Harwich.—November 24th. Electricity Department. Consumers' meters. (See this issue.)

India.—December 4th. India Store Department, Belvedere Road, S.E. One 300-b.h.p., 3,000-V, 3-phase, slip-ring motor; 325- and 50-kW oil-engine generating sets. (See this issue.)

Littleborough.—November 17th. Urban District Council. Electric lighting installation for 16 houses. Specification from surveyor to Urban District Council, Council Offices.

London.—LAMBETH.—November 18th. Board of Guardians. Electrically-driven hydro-extractor. Mr. J. L. Goldspink, clerk, 128, Brook Street, Kennington, S.E.11.

Manchester.—November 20th. Electricity Committee. Coal for 3, 6, or 12 months, commencing January 1st, 1925. Form of tender from Mr. S. L. Pearce, chief engineer and manager, Electricity Department, Town Hall, Manchester.

Mold.—December 6th. Urban District Council. Works and apparatus in connection with the distribution of electricity in the urban district. (November 7th.)

New Zealand.—AUCKLAND.—December 11th. City Tramway Department. One motor generator, one 30- and one 5-h.p. motors, switchboard, portable electric drill, and travelling hoist.*

Perth.—November 24th. Electricity Department. One 2,000-kW d.c. turbo-alternator, with condensing plant. (November 7th.)

Peterborough.—November 14th. Corporation. Electric lighting installation at the Isolation Hospital, Fengate. Mr. W. T. Mellows, Town Clerk, Town Hall.

South Africa.—JOHANNESBURG.—December 10th. South African Railways and Harbours Board. Electrification of Cape Town suburban railways. 83 motor-coach underframes (steel) and 83 motor-coach bodies (wood or, alternatively, steel); bogies and electrical equipment are not included. Specifications from the Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2.

DURBAN.—December 3rd. Electricity Department. E.h.p. and h.p. switchgear.

December 10th. Five e.h.p., 3-phase, draw-out type switch cubicles. Borough Electrical Engineer, Town Hall, Durban.—*South African Power Engineer.*

Spain.—MADRID.—Spanish Ministry of Communications. 60 tons of electrolytic copper wire, 3 mm. diameter, for the use of the telegraph and telephone service.

Walsall.—November 14th. Electric Supply Department. E.h.p. and m.p. cables. (October 31st.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Closed.

Aberayron.—Governors of the Council School. Accepted:
Installing electric light at the schools.—Eric Richards, of the Electricity Supply Co.

Alderley Edge.—Urban Council. Accepted:—
Wiring houses for electric light.—Wood & Tennant.

Argentina.—BUENOS AIRES.—Buenos Aires and Pacific Railway Co., Ltd. Accepted:—
Electric signal equipment.—Tyer & Co., Ltd.—*Modern Transport.*

Cornforth.—Parish Council. Accepted:—
Electric lighting.—F. Reid, Ferens & Co.

Irish Free State.—CLONMEL.—Corporation. Accepted:—
Three (crude) oil engines (£4,100).—Ruston & Hornsby, Ltd.
Alternators (£1,228).—Siemens Schuckert.
Switchgear (£595).—Western Electric Co., Ltd.
Wiring and cable (£2,734).—Irish Electrical Construction Co.
Power house.—Roche, Morrissey & Kennedy.

Liverpool.—Mersey Docks and Harbour Board. Accepted:—
Electric cranes for South Gladstone Dock shed, &c.—Twelve 3-ton portal cranes, nine 1-ton roof cranes, ten 3-ton roof cranes.—Stothert & Pitt, Ltd.

Australia.—MELBOURNE.—Postmaster-General's Department. Accepted:—
Insulators for the various States.—£22,283, R. Fowler, Ltd.; £8,199, Jas. Chambers & Co. Pty., Ltd.; £35,469, Firebrick Insulator & Pottery Co.; £17,667, Drayton Bros.; £522, Astra Insulators, Ltd.; £3,541, F. S. Lee, Ltd.
Telephone parts.—£4,670, British L.M. Ericsson Manufacturing Co., Ltd.; £101, Phœnix Telephone & Electrical Works, Ltd.; £366, Drummoyne Electric Engineering Works; £4,937, Western Electric Co., Ltd.
Bronze wire.—£49,252, Thos. Bolton & Sons; £47,909, F. Smith & Co.
Copper wire.—£56,310, R. Johnson & Nephew, Ltd.
H.d. copper wire.—£322,585, British Insulated & Helsby Cables, Ltd.
Motors for telephone exchange, Canterbury, Vic. (£373).—Noyes Bros. (Melb.) Pty., Ltd.
Five sections of switchboard, additions to existing c.b. switchboard at Adelaide telephone exchange (£3,612).—British General Electric Co., Ltd.

SYDNEY.—N.S.W. Railways and Tramways.
400 double-battery train lighting sets covering three years' supply (£91,225).—Coates & Co. Pty., Ltd.
Two 250-kVA transformers (£680).—English Electric Co., Ltd.
—*Tenders.*

Electricity Supply Committee. Accepted:—
2,000-kW rotary converters for Phillip Street and Lang Park sub-stations (£18,022).—English Electric Co. of Australia, Ltd.

London.—GENERAL POST OFFICE.—Accepted:—
Supply of all-porcelain switches.—Edison Swan Electric Co., Ltd.

WAR OFFICE. Accepted:—
100 voltmeters.—Park Royal Engineering Co., Ltd.

Luton.—Town Council. Accepted:—
Two rotary converters (£6,640).—Mather & Platt, Ltd.

Maidstone.—Town Council. Accepted:—
Switchgear for a new turbine, &c. (£1,650).—General Electric Co., Ltd.
The other tenders were: Metropolitan-Vickers Electrical Co., £1,722, and the British Thomson-Houston Co., Ltd., £1,734.

South Africa.—JOHANNESBURG.—South African Railways and Harbours Board. Accepted:—
Supply of electric lamps for 12 months.—General Electric Co., Ltd.

It is stated that the contract represents about one-third of the total lamp requirements of South Africa.

Municipal Council. Accepted:—
One 75-h.p., 3-phase motor, with oil switch, ammeter, &c. (£162).—C. Kelley & Partners.
Two 100-kVA oil-cooled transformers, one set of spare coils (£260).—Metropolitan-Vickers Electrical Co., Ltd.
Two 150-kVA oil-cooled transformers, one set of spare coils (£359).—G. H. Langler & Co.
Six 3-phase truck-type ironclad switch panels, fitted with 250/15-amp. current transformers: six ditto ditto, fitted with 150/15-amp. ditto (£1,134).—Wilson & Herd, Ltd.
Electric cable.—Western Electric Co., Ltd. (£16,140); Metropolitan-Vickers Electrical Co., Ltd. (£114); Telegraph Manufacturing Co., Ltd. (£1,529).—*South African Power Engineer.*

Southam (Warwickshire).—Parochial Church Council. Accepted:—
Installing electric lighting at the Parish Church.—Midland Electric Light and Power Co.

Stockton-on-Tees.—Messrs. John Thompson Water Tube Boilers, Ltd., have received a contract from Vickers and International Combustion Engineering, Ltd., for two of their patent vertical straight-tube water-tube boilers, each having 9,000 sq. ft. of heating surface, and suitable for 275 lb. working pressure, for Synthetic Ammonia & Nitrates, Ltd., Billingham, Stockton-on-Tees. They are to be fired with powdered fuel upon the "Lopulco" system.

West Ham.—Town Council. Recommended:—
Coal-handling plant (£140,941).—Vickers, Ltd.
Tramcar bodies (£9,180).—English Electric Co., Ltd.
Trucks (£1,830).—Hurst, Nelson & Co., Ltd.
Motors (£2,724).—British Thomson-Houston Co., Ltd.

West Hartlepool.—The Council, after discussion, has confirmed the Electricity Committee's recommendation to accept the tender of Callender's Cable and Construction Co., Ltd., for cables at £417. It had been suggested that tenders should be obtained from foreign makers so as to compare their figures with those quoted by British firms, all of whom were inside "the ring." In reply to the discussion, however, Ald. Macfarlane (chairman of the Electricity Committee) stated that British cables were the best in the world; even America bought cable in this country. The Committee had tried all the firms, and only four of them had tendered. There was only £10 or £12 difference between them. Even supposing the foreign quotation was lower, they had to consider whether they would take the risk as to its quality. There had been a public inquiry into the matter two years ago, and the verdict was that, although there was an arrangement in this combination, the profits the firms were making were not excessive, and that, in view of the costs, the price was reasonable.

Worthing.—Town Council. Accepted:—
25-ton electric vehicle (£867).—Electromobile, Ltd.

Electricity Department. Recommended:—
Alternator (£763); rotary converter (£779).—Crompton & Co., Ltd.
Supplying and laying cables (£1,210 per mile).—Callender's Cable and Construction Co., Ltd.

Forthcoming Events.

Physical Society of London.—Friday, November 14th. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Ordinary scientific meeting.

Northampton Engineering College Engineering Society.—Monday, November 17th. At St. John Street, E.C. At 5.30 p.m. Paper on "The Mechanical Transmission of Power on Electric Locomotives——with special reference to Individual Axle Drive," by Mr. V. F. Cornish.

Dynamicables.—Tuesday, November 18th. At the Trocadero Restaurant. At 7.30 p.m. Dinner.

Illuminating Engineering Society.—Tuesday, November 18th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 8 p.m. Reports on "Important Events During the Vacation and on Developments in Lamps and Lighting Appliances."

Paisley Association of Engineers.—Tuesday, November 18th. At 16, High Street, Paisley. At 7.30 p.m. Discussion on the "New I.E.E. Regulations," to be opened by Mr. W. Blair-Smith.

Electrical Trades Benevolent Institution.—Wednesday, November 19th. At the Trocadero Restaurant. At 7.30 p.m. Annual Festival Dinner.

British Horological Institute.—Wednesday, November 19th. At the Institute, 35, Northampton Square, E.C. At 6.30 p.m. Lecture on "Some Recent Developments in Electrical Clocks," by Major C. E. Prince.

Royal Society of Arts.—Wednesday, November 19th. At John Street, Adelphi, W.C. At 8 p.m. Paper on "The Scientific Principles of Artificial Incubation," by Mr. Ll. B. Atkinson.

Institution of Electrical Engineers.—Thursday, November 20th. At the Institution, Victoria Embankment, W.C. At 6 p.m. Paper on "Automatic and Semi-Automatic Mercury-Vapour Rectifier Sub-stations," by Mr. G. Rogers.

(Mersey and North Wales, Liverpool, Centre).—Monday, November 17th. At the University, Liverpool. At 7 p.m. Paper on "An Electric Harmonic Analyser," by Messrs. J. D. Cockcroft, R. T. Coe, J. A. Tyacke, and Prof. Miles Walker.

(North-Midland Students' Section).—Tuesday, November 18th. At the Leeds University. At 7 p.m. Paper on "E.h.p. Switchgear," by Mr. G. L. E. Metz.

(East Midland Sub-Centre).—Tuesday, November 18th. At the College, Loughborough. At 6.45 p.m. Paper on "General and Technical Ideas from the Experience of a Meter Engineer," by Mr. W. Lawson.

(North-Western Centre).—Tuesday, November 18th. At the Engineers' Club, Manchester. At 7 p.m. Informal meeting; discussion on "Wiring for Lighting, Heating and Domestic Services," to be opened by Mr. W. A. Shaw.

(Scottish Students' Section).—Friday, November 21st. Paper on "Electricity on Farms," by Mr. J. T. Allan.

(Sheffield Sub-Centre).—Wednesday, November 19th. At the Royal Victoria Hotel, Sheffield. At 7.30 p.m. Paper on "Some Recent Researches on the Safe Use of Electricity in Mines," by Prof. W. M. Thornton.

Manchester Electro-Harmonic Society.—Friday, November 21st. At the Albert Hotel, Piccadilly, Manchester. At 7 p.m. Concert.

Edinburgh Electrical Society.—Friday, November 21st. At the Philosophical Institute, 4, Queen Street. At 8 p.m. Paper on "Tariffs and Consumers," by Mr. W. Duncan.

Junior Institution of Engineers.—Friday, November 21st. At 39, Victoria Street, S.W. At 7.30 p.m. Lecturette, "Stainless Steel," by Mr. J. G. Hopcroft.

The "Electrical Review" Service Department.

INQUIRIES must be accompanied by a stamped addressed envelope.

We should be glad to learn the names of makers or suppliers of:—

Revolution counters for high speed continuous working, suitable for winding machines.

Police lanterns.

Hard steel resistance wire.

Notes.

Development Work in New Zealand.—The Wellington correspondent of *The Times* says that in his annual statement the Minister of Public Works, Mr. Coates, proposes the expenditure of £1,200,000 on railway construction, £1,332,000 on roads, and £1,133,000 on hydro-electric development. Mr. Coates lays stress on the importance of the work of development still to be done, but points out that the progress of the work must be regulated according to the labour and the money available.

A Large Turbo Rotor.—The accompanying illustration shows the forging for the 25,000-kW, 1,500-r.p.m. turbo-generator which is being supplied by the Metropolitan-Vickers Electrical Co., Ltd., to Liverpool Corporation. The forging weighs 42 tons and is bored from end to end; the weight of

A Large M.-V. Turbo Rotor.

the complete set will be 311 tons. Other M.-V. turbo sets in the Lister Drive station are two of 2,000 kW, d.c. (pre-war), one of 10,000 kW, a.c., and two of 12,500 kW, a.c., all these running at 1,500 r.p.m., except the last two, which run at 3,000 r.p.m.

Appointments Vacant.—Switchboard attendant for the Wolverhampton Corporation Electricity Department. Assistant charge engineer for the Islington Borough Council Electricity Works. Electrical fitters (£400) for the Government of the Gold Coast. Telegraph foremen (£400) for the Government of the Gold Coast. Plumber-jointer for the Stoke Newington Borough Council Electric Lighting Department. Shift engineer for Darwen Corporation Electricity Department. (See our advertisement pages to-day.)

Local Societies.—COLLIERY TESTING.—An interesting address was delivered before the South Wales branch of the Association of Mining Electrical Engineers by Mr. F. C. Knowles (of Messrs. Evershed & Vignoles, Ltd.), at Cardiff, on November 8th, on electrical testing in collieries. He described at length the various methods and instruments used, and numerous lantern slides illustrated the different contrivances. Mr. Knowles stated that the testing of electrical apparatus was of great importance to the colliery engineer, as failure in any direction might mean jeopardising the lives of men. The Coal Mines Act and memoranda suggested various tests which should be carried out periodically, but in view of the very extensive duties of the colliery engineer and electrician it was necessary that they should be conducted in the minimum of time with reliable and simple apparatus.

District Joint Board Luncheon.—The final meeting of the North-Western Area District Joint Board for the year ended November 9th took place in the Town Hall, Manchester, on November 4th, and was made the occasion of a luncheon, at which Alderman H. Clark (Rochdale) presided. Mr. Williams, E.P.E.A. (Manchester) proposed a vote of thanks to the chairman, and expressed the appreciation of the staff members of his strict impartiality and the expeditious manner with which he conducted the business of the Board. Alderman Clark thanked the members for their confidence, and stated that he was proud of the judicial spirit with which both sides had approached every problem during the year. He was firmly of opinion that the District Board was doing excellent work for the industry. Mr. R. Blackmore (Stalybridge) proposed a vote of thanks to Mr. H. A. Gray, E.P.E.A. (Manchester), leader of the E.P.E.A. side, for his able services as vice-chairman. Mr. Gray, in acknowledging this, said that he considered the North-Western Board the most important in the country. Alderman C. Higham (Blackburn) proposed a vote of confidence in the National Joint Board. He said that collective negotiation on national and district lines was a procedure which had become part of our industrial life. Alderman Walker (chairman of the National Board) responded, and Mr. Jones (general secretary, E.P.E.A.) also spoke.

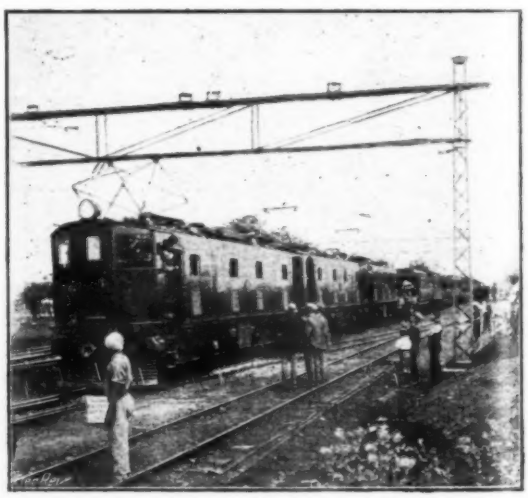
1,000,000-Volt Testing.—It is reported that the Hermsdorf Schomberg Isolatoren, Freiburg, Saxony, is using pressures up to 1,000,000 V in its laboratories for testing purposes.

The Future of the Electric Vehicle.—In the course of an interesting article in *Motor Transport*, on commercial road transport, Col. R. E. Crompton, M.Inst.E.E., traces the history of the development of commercial motor vehicles and road transport during the past 21 years. With regard to the future Col. Crompton writes:—"Probably one of the most interesting further developments that we are likely to see will be the increasing use of the electrically-driven vehicle, its power being derived from accumulators carried on the vehicle. Again, as soon as electrical energy is distributed widely throughout the kingdom, as is certain to be the case, we may very possibly see trains of commercial vehicles obtaining their energy, trolley fashion, from roadside cables connected with the great electrical centres of supply; and, as far as present designs go, this is likely to be the mode by which goods and passengers can be carried on our roads at the lowest possible cost of power, wages, and maintenance."

Fractional Horse-power Motors.—The field of application for fractional-horsepower electric motors is so wide that great skill and attention to detail, coupled with a considerable knowledge of the requirements, are vital to the production of a really successful range. That Messrs. Pooley & Austin have succeeded in this task is evident from the large number of prominent manufacturers of apparatus of the most diverse character, who have standardised the Wilson-Wolf motors for the electrical driving of their productions. To demonstrate the above statements the firm has arranged a special display at its Westminster showrooms with the assistance of many of the manufacturers referred to above. Space being limited, the display consists of only about 30 exhibits, but they are representative of the wide field open to fractional-horsepower machines. A visit is worth while; the interesting apparatus loaned to customers shows the motors to be "at home" on any job and that they fill the need adequately.

Educational.—BATTERSEA POLYTECHNIC.—We have received a copy of the report of the Principal (Mr. R. H. Pickard) for the session 1923-24, and the August list of examination results. Although the work has been satisfactory in all departments, the Principal states that there was again a decrease in the number of students. Good attendance is recorded for the Electrical Engineering Department.

South African Railway Electrification.—The accompanying illustration depicts the first of the new electric trains to run on the Glencoe-Maritzburg section of the South African



The First Electric Train on the Glencoe-Maritzburg Section of the South African Railways.

Railways. The photograph was taken as the train was leaving Colenso station on its first run on October 9th.

The Electrical Trades Benevolent Institution.—We are informed that a very high-class entertainment is being arranged for the Festival, which takes places at the Trocadero Restaurant, London, on Wednesday, November 19th. The services of celebrated theatrical and concert-hall artistes are being acquired, including Mr. Harry Dearth, the noted opera singer. There is every promise of a most enjoyable evening, and those desirous of attending should apply for tickets immediately to Mr. F. B. O. Hawes, hon. sec., E.T.B.I., 98, Grosvenor Road, London, S.W.1.

Modern Stage Lighting.—London's new theatre, "The Fortune," in Russell Street, Drury Lane, was opened on November 8th. It is built of ferro-concrete, and is claimed to be fireproof. All the electric lights are hidden, including even the footlights, and the stage lighting is carried out by the latest form of Schwabe-Hasait apparatus, which was described in our issue of March 16th, 1923, when first installed in London.

Fuels for Heavy-Oil Engines.—The specifications contained in the B.E.S.A. Publication No. 209-1924 (petroleum and shale oils) are some of the first fruits of the sectional committee on petroleum products recently set up by the British Engineering Standards' Association. Specifications are given for four grades of fuel oil, the first grade being a gas oil and the other three being non-distillate oils, all classes of heavy-oil engines thus being catered for by one or other of the four grades. No mention of specific gravity is made. In the past many specifications have called for a definite specific gravity and a definite viscosity, but the conclusion has been reached that it is quite unnecessary to specify the specific gravity of a fuel oil provided the viscosity characteristics are clearly defined. The sulphur content is not specified. While drawing up these specifications every effort was made to obtain evidence to prove that the harmful effects attributed to oils in certain cases were due to the sulphur in the oil. Pending the production of such evidence, it has been decided that, in the case of fuel oils for heavy-oil engines, as distinct from fuels for use under boilers, a test for sulphur unnecessarily increases the cost of the oil. The specifications will be revised, if necessary, in 12 months' time. The methods of testing the oil given are those adopted by the Institution of Petroleum Technologists, and are described in detail. Copies may be obtained from the B.E.S.A. Publications Department, 28, Victoria Street, S.W.1, price 1s. 2d., post free.

Fire.—There was an outbreak of fire on November 5th at the electrical store of Mr. Gorman, Colne Road, Brierfield, which was well stocked with goods.

The *Daily Mail* reports that a fire broke out in the storerooms of the Morgan Crucible Co., Ltd., Church Road, Battersea, S.W., on November 3rd. The ignition of quantities of carbon produced dense clouds of smoke which hindered the fire brigades, but the flames were soon extinguished.

Inquest.—An inquest into the death of William Banks, sheet metal worker, was held at Hackney on November 3rd. Mr. A. Davies, partner of the deceased, stated that Banks had connected up a few feet of flex with a plug and had received a shock while standing in a pool of water. The current was alternating current at a pressure of 220 V. Another witness said that the pressure to earth was 500 V; the flex which deceased was using had been repaired and badly insulated. Evidence was given that artificial respiration had been resorted to, but without effect. In returning a verdict of "Accidental death," the Coroner emphasised the importance of the application of artificial respiration for long periods in such cases.

Institution Notes.

Institution of Electrical Engineers.—At the ordinary meeting of the Institution in London on November 6th, at which Prof. Miles Walker read the paper on "An Electric Harmonic Analyser," which is abstracted in this issue, the President (Mr. W. B. Woodhouse) announced that Sir Oliver Lodge had that day been elected an honorary member of the Institution. Mr. Woodhouse said that Sir Oliver had been a member of the Institution since 1889, and his work in many fields, notably those of radio-telegraphy and electrical precipitation of gases, fully merited the honour which the Council had been privileged to bestow upon him.

NORTH MIDLAND CENTRE.—The meetings of this Centre (Leeds), not including those of the Sheffield Sub-Centre, are as under, the session having opened on the 11th inst. with the chairman's address and a smoking concert:—

November 25th.—"Automatic and Semi-Automatic Rectifier Sub-Stations," by Mr. G. Rogers.
December 9th.—"Power Circuit Interference with Telegraphs and Telephones," by Mr. S. C. Bartholomew.
January 13th.—President's meeting.
January 27th.—Faraday Lecture on "World-wide Radio Telegraphy," by Prof. G. W. O. Howe.
February 10th.—Informal discussion on "Domestic Electrical Apparatus." (British Electrical Development Association.)
February 24th.—"Selection of Ball and Roller Bearings for Electrical Machines," by Mr. T. D. Trees.

NORTH MIDLAND STUDENTS' SECTION.—On Tuesday evening next, November 18th, at the Leeds University, this section will have under consideration the paper read last session before the Manchester Students' Section by Mr. G. L. E. Metz, on "E.H.T. Switchgear." Other arrangements that have been made include the following:—December 2nd: Discussion at Bradford Technical College on "Probable Development in the Generation and Distribution of Electrical Power in the Next Ten Years." December 16th: Paper to be read at Leeds University by Mr. W. F. Cooper, on "The Mechanical and Magnetic Properties of Steel."

SHEFFIELD STUDENTS' SECTION.—On Wednesday evening Mr. E. Duffield read a paper on "Storage Batteries." On December 10th Mr. G. Lindley, M.Sc., will deal with "Super-Conductivity." There will be a smoking concert, at which the chairman's address will be delivered, on January 13th; and on February 11th "Magnets" will be the subject of a paper by Mr. C. Harrison.

SCOTTISH CENTRE.—The annual report shows that seven general meetings were held during 1923-1924 session, and the Committee reports an improvement in the attendance and satisfactory general discussions. The Scottish Centre meeting at Dundee took place on April 25th, 1924, at the University College, and was preceded by luncheon and a visit to Belmont Castle. The night, as well as Saturday, were spent by many at Carnoustie. A sub-committee was appointed to consider ways and means of bringing the work of the Centre more prominently before the members, and it is hoped to institute some meetings of a more popular and less formal nature. The dinner and a smoking concert were both well attended. The session ended with a total membership of 658, an increase of 10 on the previous year, and the average attendance at meetings was 81.

SCOTTISH STUDENTS' SECTION.—The report shows that seven meetings were held during the session, and were well attended, the average number present being 34. A successful smoking concert was held at Glasgow, and a party of the West of Scotland students visited Edinburgh on February 2nd, 1924, and were joined by a number of East of Scotland students, visiting West Bank power station at Portobello, and the afternoon was spent in visiting the Lothian Power Co.'s 30,000-volt Esk Bank sub-station, and Preston Grange Colliery, Prestonpans. The membership now numbers 162. The scope of the section could with advantage be somewhat extended to incorporate more meetings and visits, says the Committee.

DUNDEE SUB-CENTRE.—The annual report of the Committee indicates that seven meetings and a successful smoking concert were held, and about 60 members responded to the courteous invitation of the Post Office officials to be shown round the new automatic telephone exchange.

Junior Institution of Engineers.—On Friday last, Mr. H. C. Jones delivered a lecturette on "Fire Engine Construction." He described the old forms of engines, manual pumps, and steam pumps, and the transformation from horse to mechanical traction. The petrol-driven engine was a considerable improvement on the steam-operated engine, because it could turn out to a fire and start pumping at once.

Our Personal Column.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Mr. ALEXANDER LINDSAY is the chairman of the Scottish Centre of the Institution of Electrical Engineers. He received his electrical training at the Glasgow and West of Scotland Technical College, and served his apprenticeship at the Clydebank Engineering and Shipbuilding Works, Clydebank. Mr. Lindsay has been established in business as an electrical contractor in Glasgow since 1901, and he is on the National Register of Electrical Installation Contractors, of which authority he is a member. His firm has carried out a large number of installations in different parts of the United Kingdom. Mr. Lindsay joined the Institution of Electrical Engi-

Mr. Alexander Lindsay,
CHAIRMAN OF THE SCOTTISH CENTRE OF THE I.E.E.

neers as an Associate in 1899, became an Associate Member in 1903, and later a full member. He is a past-president of the Scottish Electrical Contractors' Association, and is at present Deacon of the Incorporation of Tailors of the City of Glasgow.

Mr. E. P. BENNETT, of Messrs. Cargills, Ltd., export merchants, has returned from Australia and New Zealand, both of which countries he covered twice during his 10 months absence overseas. Messrs. Cargills, 119-125, Finsbury Pavement, London, E.C.2, will be pleased to receive catalogues and price information from manufacturers of electrical and general engineering material.

Mr. ERIC BAXTER, of Blackpool Electricity and Tramways Department, was presented with a Jacobean oak case bureau, on November 7th, on the occasion of his leaving Blackpool to take up an appointment as traffic superintendent at South Shields. He was also presented with a cheque by his colleagues of the Electricity and Tramways Institute.

At a meeting of the Council of the University of Birmingham last week the following appointments were made:—Mr. A. R. BOWEN to be research worker in the Department of Oil Mining for the session 1924-25; Mr. S. H. EDGAR and Mr. A. BINNS to be teaching scholars in the Departments of Chemistry and Electrical Engineering, respectively, for the session of 1924-25.

Mr. BOYLE, who has been acting as clerk of works, has been appointed electrical engineer to the Scunthorpe and Frodingham Urban Council's electricity undertaking, at £400 a year.

Alderman J. H. PALIN, Socialist Member of Parliament for Newcastle-on-Tyne (West), and Lord Mayor of Bradford for the coming year, has been the Bradford area secretary for the General Vehicle Workers' Union since the merging into that body of the former Tramway and Vehicle Workers' Union, of which he was general secretary.

Mr. F. W. MOZLEY, of Nelson, a son of Mr. Mozley, the Burnley tramway manager, has been appointed engineer and surveyor of Bacup.

At a meeting of the South Wales branch of the Association of Mining Electrical Engineers on November 8th, Mr. Idris Jones (chairman), on behalf of the members, presented an illuminated address to Mr. LLEWELLYN HUGHES, M.S.M.I.A., A.M.I.E.E., on his departure from South Wales to Australia. Mr. Hughes was a vice-chairman of the branch, and prior to his becoming an electrical engineer worked as a miner. Subsequently he was employed by the Powell Duffryn Company as an electrical engineer.

MESSRS. HENRY LEA & SON, consulting engineers, Birmingham, are to-day moving their offices, and their new address is 151-153, Edmund Street, Birmingham. Telephone No. "Central 113"; Telegraphic address, "Engineer, Birmingham," both as before. Messrs. Lea have closed their Liverpool office, the work which necessitated it being now completed.

Will.—The late SIR W. A. HERDMAN, F.R.S., a president of the British Association and foreign secretary to the Royal Society, left £38,282 gross and £24,955 net personalty.

New Companies Registered.

Unbreakable Pulley and Millgearing Co., Ltd. (201,324).—Private company. Registered October 28th. Capital, £30,000 in £1 shares. To acquire the business of a company of the same name (incorporated in 1902) recently carried on in Manchester, and part of the assets of that company, and to carry on the business of pulley makers, mechanical and electrical engineers, tool makers, boiler makers, &c. The subscribers (each with one share) are:—P. F. Hedge, The Friars, Southend Road, Hockley, Essex, managing clerk; W. B. Percy, 219, Barcombe Avenue, Streatham Hill, S.W.2, clerk. The subscribers are to appoint the first directors. Qualification £200. Remuneration as fixed by the board. Solicitors: Peter Thomas & Clark, 1, Bush Lane, E.C.

St. Marks Electrical Co., Ltd. (201,467).—Private company. Registered November 3rd. Capital, £500 in £1 shares. To acquire the business carried on by B. M. Marks as the "St. Marks Electrical Co." at 63, Dean Street, W., and to carry on the business of manufacturers of and dealers in motor car and electrical accessories and general engineering appliances, &c. The first directors are:—B. M. Marks, 27, Canfield Gardens, Hampstead, N.W., electrical engineer (permanent); A. Marks, 10, Ossington Road, Westcliff-on-Sea, stockbroker. Qualification, 25 shares. Solicitor: W. P. Armstrong, 4, Vernon Place, Bloomsbury, W.C. Registered office: 63, Dean Street, Shaftesbury Avenue, W.1.

Simon Bros. (Engineers), Ltd. (201,423).—Private company. Registered November 1st. Capital, £2,000 in £1 shares. To carry on the business of consulting chemical, electrical, and mechanical engineers, designers and manufacturers of all classes of machinery, &c. The permanent directors are:—L. J. Simon, 5, Holmdene Avenue, Herne Hill, S.E., consulting engineer; A. Simon, 39, Coburn Street, Fow, E., electrical engineer. Qualification, 1 share. Remuneration as fixed by the company. Solicitors: Norman Hart and Mitchell, 21, Panton Street, S.W.1. Registered office: 21, Panton Street, Haymarket, S.W.1.

Belbin & Bowden, Ltd. (201,363).—Private company. Registered October 30th. Capital, £500 in £1 shares. To carry on the business of manufacturers of and dealers in drawn wire, electric cabling and lamps, electrical implements and appliances and metal products, wireless apparatus and parts thereof, &c. The directors are:—H. Belbin, 88, Charterhouse Chambers, E.C.1, merchant; Capt. S. V. Bowden, 102, Oxford Gardens, W.10. Qualification, £1. Remuneration as fixed by the company. Solicitors: Fowler, Legg & Young, 13, Bedford Row, W.C.1. Registered office: 88, Charterhouse Chambers, Charterhouse Square, E.C.1.

Ena Electrical Appliances, Ltd. (201,493).—Private company. Registered November 5th. Capital, £1,000 in £1 shares. To acquire the business of electrical engineers now carried on at 62, Englefield Road, London, as "Ena Electrical Appliances Co." The directors are:—F. A. Nash, 20, Balmoral Road, Leyton, E.10; F. A. Camp, Ingleside, Ashburnham Gardens, Upminster, Essex; C. E. Lawrence, 34, Lorne Gardens, Park Road, N.W.8. Qualification, 200 shares.

C. & B. Dawson & Brothers, Ltd. (201,391).—Private company. Registered October 31st. Capital, £2,000 in £1 shares. To carry on the business of electricians, mechanical engineers, manufacturers of and dealers in radio apparatus, &c. The subscribers (each with one share) are:—T. W. E. Towers, 43, Sunwell Street, Peckham, S.E.15, manager of wireless apparatus manufacturers; J. Bridgman, 19, Auckland Road, Ilford, managing clerk. The subscribers are to appoint the first directors. Qualification, 5 shares. Remuneration as fixed by the company. Secretary: J. Bridgman. Solicitors: De Moza and Menasse, Bank Chambers, 214, Bishopsgate, E.C.

British Radio Corporation, Ltd. (201,486).—Private company. Registered November 5th. Capital, £2,000 in £1 shares (1,000 ordinary and 1,000 7½ per cent. cumulative preference). To acquire the business carried on at Elm Grove, Weybridge, by Mass Cars, under the style or firm of Taylor, Taylor & Parkinson, and to carry on the business of manufacturers of and dealers in drawn wire, electric cabling and lamps, wireless, aeronautical, electrical, kinematograph and photographic apparatus, &c. The first directors are:—W. J. Masser-Horniman, Woodcote Manor, Alresford, Hants., proprietor, of "Mass Cars," 10, Milverton Street, Kennington, S.W.; E. A. Taylor, Gresham Cottage, Sea Street, Herne Bay, radio engineer (managing director). Qualification, 50 shares. Remuneration as fixed by the company. Solicitors: Fowler, Legg & Young, 13, Bedford Row, W.C.1.

Ebonite Container Co., Ltd. (201,538).—Private company. Registered November 7th. Capital, £22,000 in £1 shares. To acquire the business of manufacturers of ebonite containers and allied products and manufacturing specialists to the accumulator and electrical trades now carried on by Sophie Kenrick Bevan and John N. Keenan at Belle Isle, York Road, N.7, as the "Ebonite Container Co." The subscribers (each with one ordinary share) are:—H. Bell, 35, Brooke Street, Holborn Bars, E.C.1, chartered accountant; Capt. C. F. Bird, 134, Shooter's Hill Road, Blackheath, S.E.3. The permanent directors are:—Sophie K. Bevan and J. N. Keenan, addresses not stated. Qualification of Sophie K. Bevan, 3,000 shares; of J. N. Keenan, 1,500 shares; of other directors, 500 shares.

Westminster Battery Co., Ltd. (201,549).—Private company. Registered November 7th. Capital, £500 in £1 shares. To carry on the business of manufacturers of, and dealers in electric batteries, accumulators, electrical, magnetic, galvanic, wireless, telegraphic, telephonic, and other apparatus, &c. The subscribers (each with one share) are:—H. E. Bunk, 10, Coleman Street, E.C.2, C.A.; and A. Scott-Mowat, 74, Broadhurst Gardens, West Hampstead, N.W.6, foreign exchange broker. A. Scott-Mowat is the first director. Solicitors: Sparks, Russell, Isard & Co., 32, Walbrook, E.C.4. Registered office: 68a, Southgate Road, N.1.

Yorkshire Electric Transformer Co., Ltd. (201,550).—Private company. Registered November 7th. Capital, £2,000 in £1 shares. To acquire the benefit of certain existing inventions relating to engineering, &c. The subscribers (each with one share) are:—W. M. Lydall, A.M.I.E.E., 91, Grasmere Road, Huddersfield, engineer; G. Glendinning, Arley House, Savile Road, Thornhill Road, Huddersfield, manufacturer; and W. E. Brown, A.S.A.A., A.C.I.S., 11, Belsize Gardens, Hampstead, N.W.1, incorporated accountant. W. M. Lydall is life managing director. Secretary: W. E. Brown.

Official Returns of Electrical Companies.

Anglo-Portuguese Telephone Co., Ltd. (24,545).—Return dated June 30th, 1924. Capital, £500,000 in £1 shares. 400,000 shares taken up. £301,046 paid. £98,954 considered as paid. Mortgages and charges, £70,470.

Lancashire Dynamo and Motor Co., Ltd. (61,447).—Return dated April 21st, 1924. Capital, £250,000 in 200,000 ordinary and 50,000 preference shares of £1 each. 174,120 ordinary and 48,800 preference shares taken up. £222,920 paid. Mortgages and charges, £75,000.

Everett (Southampton), Ltd. — Charge on present and future book debts dated October 18th, 1924, to secure £600 and further advances not exceeding in all £1,000. Holders: Hartley Engineering Co., Ltd., Hartley Chambers, 110, High Street, Southampton.

Northwich Electric Supply Co., Ltd.—Issue on October 31st, 1924, of £3,250 debentures, part of a series already registered.

Adaptable Code Condensers, Ltd.—Mortgage dated October 20th, 1924, to secure £600, charged on 55, Pelham Road, Wimbledon. Holders: J. G. Radley, 84, Conyngham Road, Rusholme, Manchester, and others.

Herbert Ward, Ltd.—Satisfaction in full on November 1st, 1923, of debenture dated January 10th, 1920, securing £600. (Notice filed October 28th, 1924.)

Electro-Dynamic Construction Co., Ltd.—Particulars filed of £1,500 debentures authorised October 22nd, 1924, charged on the company's undertaking and property, present and future, including uncalled capital, the amount of the present issue being £500.

City Notes.

Montevideo Telephone Co., Ltd.

The annual meeting was held on November 5th, Mr. A. Anns (managing director) presiding in the absence of Viscount St. Davids. The chairman said that the cash position showed a satisfactory improvement, and the loss of subscribers occasioned by the action of the Uruguayan Government had been made good. Rental revenue had increased, and this, coupled with a larger return from investments, raised the gross revenue by £3,722, and the profit balance from £17,182 to £22,699. (The method of disposal of this profit was given in our issue of October 31st, p. 666). The contract of the Uruguayan Government with the Western Electric Co. for the installation of an underground telephone system in Montevideo had not yet been settled. The directors of the company were doing everything possible to improve the existing service, but in the absence of permission to put their main routes underground, it was not possible to give the city the service to which it was entitled. A draft form of concession had actually been settled with the Post Office Department, but the Government had so far failed to adopt the arrangement.

Amazon Telegraph Co., Ltd. The report for the year ended June 30th last shows a gross revenue of £52,778 and working expenses amounting to £25,208. After providing for income tax and debenture interest and contributing £14,699 to the sinking fund and £1,500 to general reserve, there remains a balance of £3,066, which the directors recommend shall be carried forward, subject to corporation profits tax. There has been some improvement in business on the Amazon but the rate of exchange remains very low. The meeting is to be held on Tuesday next.

Erinoid, Ltd. Speaking at the annual meeting of the company on November 4th, the chairman (Mr. A. Binnie) said that there had been an increase of £10,000 in the net profit, of which £7,000 was due to an increase in trading profits. He thought that the French company would develop during the present year; the Erinoid company's interests were adequately safeguarded by the directors who had been appointed to the board of the French company. They had received fully-paid shares in the Casein Co. of America for their American connection and goodwill, and they would be represented on the board of that company. The British Empire Exhibition had done much to bring "Erinoid" to the notice of the British, Colonial, and foreign public.

Drake and Gorham, Ltd. The net profit for the year ended June 30th last was £3,842, as compared with a loss of £11,013 in the preceding year. A debit balance of £59 is deducted from this, £3,500 is transferred to reserve, and the balance of £283 is carried forward. Although the results showed a marked improvement, heavy taxation still restricts business with the class of clients upon which the company largely depends. The associated companies, which also incurred losses in 1922-23, have been able to show a small profit. It is hoped that the extension of electricity supply which is now taking place will lead to increased business.

Paper Mark Capital. The process of converting the paper mark shares into gold mark capital is continuing. The *Felten and Guilleaume Company*, of Cologne-Mulheim, proposes to reduce the nominal value of the 1,000 mark shares to 300 gold marks and the total capital from 200,000,000 marks to 60,000,000 gold marks. The Electricity Company (late Lahmeyer), of Frankfort-on-Main, is reducing the shares from 1,000 marks to 150 gold marks, while the accounts for the six months ended with June 30th, 1924, show net profits of 72,000 gold marks. In the case of the German Cable Works Company, of Berlin-Lichtenberg, the paper mark capital is to be reduced in the ratio of 50 to 1 in gold marks; the paper capital of 17,000,000 paper marks of the Electro-Vulcan Company, of Nuremberg, is to be reduced from 17,000,000 marks to 204,000 gold marks; and that of the Dortmund Cable Works, of Dortmund, is to be transformed in a similar manner.

Stock Exchange Notices.—Dealings in the following have been specially allowed by the Committee under Rule 159:—

Edmundsons' Electricity Corporation.—400,000 seven per cent. cumulative preference shares of £1 each, fully paid, Nos. 1 to 400,000; and 400,000 ordinary shares of £1 each, fully paid, Nos. 400,001 to 800,000.

The undermentioned have been ordered to be officially quoted:—

Edmundsons' Electricity Corporation.—240,000 ordinary shares of £1 each fully paid, Nos. 1 to 240,000, and 400,000 seven per cent. cumulative preference shares of £1 each fully paid, Nos. 400,001 to 800,000.

Reduction of Capital.—AGRICULTURAL & GENERAL ENGINEERS, LTD., AND REDUCED.—A petition for the confirmation of the reduction of the capital from £8,000,000 to £6,757,184 has been presented to the High Court and will be heard on November 18th.

The A.E.G.—A Berlin Exchange Telegraph message, dated November 6th, stated that efforts were being made to place issue bonds to the amount of $20,000,000 for the Allgemeine Elektricitaets Gesellschaft, of which half will be for reparation purposes.

American Telephone and Telegraph Co.—The *Financial Times* reports that the net income for the nine months ended September 30th was $64,711,680, as compared with $61,256,142 in the equivalent period of 1923.

Adelaide Electric Supply Co., Ltd.—A final dividend of per cent., free of British income tax, has been declared on he ordinary shares, making 12 per cent. for the year.

Madras Electric Supply Corporation, Ltd.—An interim ividend of 2½ per cent., free of tax, has been declared upon the ordinary shares.

Electric Construction Co., Ltd.—The following interim dividends have been declared:—Preference shares, at the rate of 7 per cent.; ordinary shares, at the rate of 6 per cent.

Isle of Thanet Electric Supply Co., Ltd.—A dividend of 6 per cent., free of British income tax, has been declared on the 6 per cent. cumulative preference shares.

Richardsons, Westgarth & Co., Ltd.—Interim dividend on the ordinary shares of 2½ per cent. (6d. per share). less tax.

Stocks and Shares.

MONDAY EVENING.

THE furious pace set by business in the Stock Exchange markets, after the result of the General Election had become known, failed to stay the preliminary canter. Orders fell off to some extent. It is very noticeable, however, that prices show little setback, in spite of the dramatic advances that have occurred since the Election. Investment money has been unloosed and, for all the talk of a possible stringency in the money market, capital has flowed freely into the Stock Exchange, lifting prices and maintaining the general air of cheerfulness to which reference was made last week. The uncertainty that still continues to surround the fate of the Exhibition is a reason why the Underground Railway stocks have failed to improve upon the position which they attained last week.

Metropolitan has gone back to 76¼, and Underground Electric £10 shares are lower at 2¾. The steam stocks, after heavy rises, eased off from the top. It is expected that several new important issues will be made in the near future. East London ordinary cannot get far away from 5, and the company's "A" and "B" debentures stand at 80¼ and 77¼ respectively. The fourth debenture, in which there is a little speculation, last changed hands at 11¼, the thirds being about 29¼.

Electricity supply shares hold their rises without exception. Westminsters are a good market, showing a gain of 12s. 6d. at 11. Shares can be sold, indeed, at this figure; the attraction to buyers being the yield which the price offers. St. James's, however, at 11¼—they are 10s. up on the week—yield £6 18s. 7d. per cent. on the money. County of London pay 6 per cent., and City Lights, at their improved level of 2¾, return £6 6s. 4d. per cent. Brompton ordinary are better at 37s. 6d., and Charing Cross have risen ¼ to 2 5/16. Bournemouth and Poole continue active, and the old shares were dealt in several times at 60s., the new being but a trifle under this. It may be of service to offer the suggestion that sellers should be particular in specifying whether they hold old shares or not when instructing their brokers.

Manufacturing shares are firm also. British Aluminiums show a gain of 3s. 6d. Optimism is current in regard to the future which opens out in respect of the company's hydro-electric scheme in Scotland. It is thought that this will prove a very important factor in the company's fortunes. English Electrics at 18s. 9d. are 1s. higher, and India Rubber shares at 17s. 6d. show 1/16 gain. Siemens strengthened to 23s. 3d., Metropolitan-Vickers ordinary to 25s. There is a good deal of business doing in Brush Electric on the basis of 22s. 9d. British Thomson-Houston hardened to 22s. 9d.

The cable construction shares are steady, but show no further improvement upon the gains which they secured last week. Babcock & Wilcox strengthened to 50s., at which price the yield on the money, on the basis of the last year's dividend, looks modest enough. It is expected that this company, in common with all the other sound concerns engaged in similar business, will participate substantially in the trade revival which everyone is talking about as likely to take place under a stable Government.

British Electric Traction rose 2 to 97½, and London transport shares have not varied. Brazilian Tractions are lower, showing a loss, at 56, of a point on the week, the price being now ex dividend. Mexico Tramways 5 per cent. bonds shed 6 points to 59, the fall coming about as quietly as the previous rise did. Mexican Light & Power preference at 60½ are 7 down, the sentiment in regard to Mexico having again changed, this time for the worse, so far as holders of Mexican securities are concerned. In the dollar group, Manila Electric Railway stock at 127½ is 3 up, and Shawinigan at 146½ put on a couple of points, though Kaministiquia fell back to 112½.

The feature amongst telegraphs and telephones is the way in which Chile Telephones spurted suddenly to 6, being 16s. 3d. higher than last week's price. The market, barely supplied with shares, was faced with a sudden rush of buying orders, but the rise brought in selling; at 5¾ the shares are still 13s. 9d. better on balance. The cable group is inclined to give way a little, Westerns being ¼ down, though Eastern Extensions at 17¼ are 5s. higher, after being 17½. Westerns are the cheapest in this group. Wireless shares are stronger, Marconis being again 1s. 6d. up at 37s. Canadian Marconis touched 8s. 6d. before losing a few pence. Manufacturing shares, as already stated, are quiescent. Isle of Thanet Tramways, which were mentioned here a week or two ago as being cheap at 4, are 4½, buying being encouraged by the idea that when dealings begin in the £1 shares, as they are expected to do almost at once, the price will look cheap at 18s., the equivalent of the present price of the £5 shares.

Edmundsons are about to be quoted as £1 shares, and in their case the quotation remains at 5¼, the yield on the money at this price being under 4 per cent. The market in all electrical stocks and shares is very hard, difficulty being experienced in obtaining stock to meet the insistent demand from buyers. The rubber share market is firm, a large volume of business being experienced during the past few business days, although a slight decline from the 1s. 6d. per lb. touched by the price of raw rubber last week, had the effect of chilling the exuberance of those who were rushing into the market with orders to buy rubber shares "at best."

Share List of Electrical Companies.

Home Electricity Companies.

	Nom.	Dividend. 1922.	Dividend. 1923.	Price Nov. 10, 1924.	Rise or fall.	Yield. p.c.
	£					
Brompton Ordinary	1	12	10	1⅞	+ 1/16	*£5 6 8
Charing Cross Ordinary	1	14	14½	2 5/16	+ ⅛	6 5 7
do. do. do. 4½ Pref.	1	4½	4½	17/6	—	5 2 10
Chelsea	1	10	12	37/6	—	6 8 0
City of London	1	15	15	47/6	+ 1/16	6 6 4
do. do. 6 % Pref. ...	1	6	6	23/-	—	5 2 2
County of London	1	10	15	2½	—	6 0 0
do. do. 6 % Pref. ...	1	6	6	23/-	—	5 4 4
Edmundson's Ordinary	8	7	7	5½	—	3 17 0
do. 6 % Pref.	5	6	6	5½	—	5 9 1
Kensington Ordinary	6	12	14	9½	—	7 5 5
London Electric	1	10	10	33/-	+ ⅛	6 1 3
do. do. 6 % Pref. ...	5	6	6	6½	—	5 14 3
Metropolitan	1	8½	10	1⅞	+ 1/16	5 6 8
do. 4½ % Pref.	1	4½	4½	17/6	—	5 2 10
Newcastle-on-Tyne Ordinary ...	1	2½	6	1 1/16	+ 1/16	5 13 0
do. 5 % Pref. ...	1	5	5	17/-	—	5 17 8
do. 7 % Pref. ...	1	7	7	25/-	—	5 12 0
Notting Hill 6 % Pref.	10	6	6	9½	—	6 6 4
North Met. Elec. 6 % Pref. ...	1	6	6	1⅛xd	+6d.	5 6 8
Urban Ordinary	1	—	4	19/3	—	4 4 8
do 6 % Pref. ...	1	5	6	19/6	—	6 3 1
St. James' and Pall Mall ...	5	14½	17½	12⅛	+ ⅛	6 18 7
South London	1	11	15	2½	+1/9	6 13 4
South Metropolitan Pref. ...		7	7	1¼	—	5 12 0
Westminster Ordinary	5	12	15	11	+ ⅛	6 16 4
Whitehall Elec. Invst. 7½ % Pref.	1	7½	7½	19/-	—	7 18 0

Home Rails.

Central London Ord. Assented	Stock	4	4	70½	—	5 14 2
Metropolitan	,,	3½	4	78½	— ⅛	5 4 7
do. District	,,	3	3½	53½	+ ⅛	6 10 10
Underground Electric Ordinary	10	Nil	Nil	2⅞	—	Nil
do. do. "A" ...	1	Nil	Nil	8/6	+6d.	Nil
do. do. Income	Bonds	5	6	99	—	*6 1 3

Telegraphs and Telephones.

Anglo-Am. Tel. Pref.	Stock	6	6	104	—	5 15 6
do. Def.	,,	1½	1½	24½	—	6 3 9
Chili Telephone	5	6	6	5⅞	+ 1/16	5 2 2
Cuba Sub. Ord.	10	7	7	7	—	10 0 0
Eastern Extension... ...	10	10	10	17½	+ ½	5 16 0
Eastern Tel. Ord.	Stock	10	10	172½	—	5 16 0
Globe Tel. and T. Ord.	10	10	10	17½	—	5 14 3
do. do. Pref.	10	6	6	11½	—	5 6 8
Great Northern Tel.	10	24	22	30½	—	7 5 8
Indo-European	25	7	7	29½	—	*5 6 1
Marconi	1	15	10	17/6	+1/6	5 6 8
Oriental Telephone Ord.... ...	1	12	12	1½	—	*8 8 0
United R. Plate Tel.	5	8	8	6⅞	+ 1/16	*5 16 5
West India & Panama	10	Nil	Nil	1/-	—	Nil
Western Telegraph	10	10	10	16½	— ½	6 3 1

Home and Foreign Trams, &c.

Anglo-Arg. Trams First Pref....	5	12½	5½	9 1/16	—	8 6 0
do. do. 2nd Pref. ...	5	5½	6	8 5/16	—	9 8 2
do. do. 5% Deb. ...	Stock	5	5	77½	+2	6 9 0
British Electric Traction Ord....	,,	5	6	97½	+2	6 3 1
do. do 6% Pref. ...	,,	6	6	102½	—	5 18 3
Brazil Traction	100	4	4	86	−1	7 2 10
Brit. Columbia Elec. Rly. Pcs.	Stock	5	5	87½	—	5 14 3
do. do. Preferred	,,	5	98/-	86½	—	*5 13 6
do. do. Deferred	,,	8	129.5	109½	+1	*5 18 2
do. do. Deb.	,,	4½	4½	81½	—	5 4 4
Lond. & Sub. Trac. 5 % Pref. ...	1	5	5½	8/-	—	6 5 0
London United Tram. Deb. ...	Stock	4	4	55½	—	7 4 2
Mexico Trams. 5% Bonds ...	—	Nil	5	73	—	6 8 4
do 6% Bonds ...	—	Nil	Nil	59	−6	Nil
Mexican Light Common ...	100	Nil	Nil	27	−1	Nil
do. Pref.	100	Nil	Nil	40½	−7	Nil
do. 1st Bonds ...	—	5	5	67	—	7 9 3

Manufacturing Companies.

Babcock & Wilcox...	1	20	12	2½	+9d.	*4 17 6
British Aluminium Ord.... ...	1	5	5	£8/-	+3/9	3 11 5
British Insulated Ord.	1	15	15	86/3	—	5 6 9
Callenders	1	15	15	£8.9xd	—	5 2 0
do. 6½ Pref....	1	6½	6½	23/9	—	5 9 5
Crompton Ord.	1	5	Nil	1⅛	—	8 17 10
Edison-Swan	4/-	7½	—	6/-	—	5 0 0
,, 5% Deb. ...	Stock	5	5	71½	—	6 10 10
Electric Construction	1	10	10	1½	+ ⅛	6 13 4
English Electric	1	8	8	12/9	+1/-	5 6 8
do. do. Pref.	1	6	6	19/6	—	6 3 1
Gen. Elec. Pref.	1	6½	6½	22/9	+ 6d.	5 14 3
do. Ord.	1	5	5	21/-	+1/-	4 15 3
Henley	1	15	15	58/9	+ ⅛	5 2 0
do. 4½ Pref.	5	4½	4½	4½	—	5 6 0
India-Rubber	1	10	5	⅞	+ 1/16	*5 14 3
Met.-Vickers Pref....	2	8	8	9⅜	—	6 14 9
Siemens Ord.	1	5	—	23/3	+9d.	4 6 0
Telegraph Con.	12	20	20	26	—	*4 12 2

*Dividends paid free of Income Tax.

Market Quotations for Chemicals and Metals.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances

CHEMICALS, &c.		Price Nov. 11.	Fortnight's Inc. or dec.
a Acid, Oxalic	per lb.	5¾d.	...
a Ammoniac, Sal	per ton	£60	...
a Ammonia, Muriate (large crystal)	,,	£52	...
a Bisulphide of Carbon	,,	...	...
a Borax	,,	£25	...
a Copper Sulphate	,,	£25 10s.	...
a Potash, Chlorate	per lb.	4d. to 4½d.	...
a ,, Perchlorate	,,	4½d.	...
a Shellac	per cwt.	£15 15s.	...
a Sulphur, Sublimed Flowers ...	,,	£7 15s.	...
a ,, Roll	,,	£7 15s.	...
a Soda, Chlorate	per lb.	3d.	...
a ,, Crystals	per ton	£5 to £5 5s.	...
a Sodium Bichromate, casks ...	per lb.	4½d.	...
METALS, &c.			
b Aluminium, Ingots	per ton	£125 to £130	...
b ,, Wire	per lb.	1/9 to 2/6*	...
b ,, Sheet	,,	1/6 to 2/-	...
p Babbitt's Metal and Anti-friction Metal—			
Grade I	per ton net	£231	£2 inc.
Grade II	,, ,,	£173	£1 inc.
Grade III	,, ,,	£7	£7 inc.
c Brass (rolled metal 2" to 12" basis)	per lb.	9½d.	½d. inc.
c ,, Tubes (solid drawn) ...	,,	11¾ to 1/-	...
c ,, Wire, basis	,,	10½d.	...
c Copper Tubes (solid drawn) ...	,,	1/1	...
c ,, Bars (best selected) ...	per ton	£94	£ inc.
c ,, Sheet	,,	£94	£1 inc.
c ,, Rod	,,	£94	£1 inc.
d ,, (Electrolytic) Bars ...	,,	£68 10s.	10/- inc.
d ,, Sheets	,,	£143 10s.	
d ,, ,, Wire Rods ...	,,	£78 10s.	10/- inc.
d ,, ,, H.C. Wire	per lb.	9 1/2d.	½d. inc.
f Ebonite Rod	,,	2/- to 3/6	...
f ,, Sheet	,,	2/- to 3/6	...
a German Silver Wire	,,	2/3	...
h Gutta-percha, fine	,,	9/-	...
h India-rubber, Para fine	,,	1/5½	½d. inc.
i Iron Pig (Cleveland Warrants) ...	per ton.	£5 2s. to £5 2s. 6d.	...
i ,, Wire, galv. No. 8, P.O. qual.	,,	£25	...
g Lead, English Pig	,,	£40 10s.	20/- inc.
g Mercury	per bot.	£10 10s.	15/- to 2 /- dec.
e Mica (in original cases) small ...	per lb.	3d. to 3/-	...
e ,, ,, medium ...	,,	4/- to 8/-	...
e ,, ,, large ...	,,	10/- to 20/- & up.	...
p Phosphor Bronze, plain castings ...	,,	1/3½	...
p ,, ,, drawn bars & rods ...	,,	1/8	...
p ,, ,, rolled strip & sheet ...	,,	1/3½	...
p ,, ,, wire	,,	1/8½	...
o Platinum	per oz.	£29	...
d Silicium Bronze Wire	per lb.	1/0½	...
r Steel, Magnet, in bars	,,	8d.	...
n Tin, Block (English)	per ton.	£260 to £260 10s.	£5 15s. to £6 inc.
n ,, Wire, Nos. 1 to 16	per lb.	9/11	...

*For 1 cwt. lots. Special quotations against definite specifications.

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

Canadian Tidal Power Project.—Progress is being made in the survey of water-power possibilities at Lubec Narrows. An engineer is superintending observers who are calculating the action and rise and fall of the tides. It is understood that the plants contemplated include the erection of a dam at Lubec, another between Deer and Campobello Islands, a third between Eastport, Me., and Deer Island, and a fourth across Letite Passage. Two basins would therefore be made available, in one of which there would always be a low tide, with turbines in all the dams opening into the low-tide area. —*Commerce Reports.*

Radio-telemechanic Experiments.—In the presence of many Italian military and naval officers and the Under-Secretary for Communications, Deputy Celesia, together with newspaper men from all parts of the world, the third public radio-telemechanic experiments took place at Spezia on November 8th with complete success, says the *Daily Telegraph*, which some time ago gave a summary description of the new radio-telemechanic invention of the Italian engineer, Normanno Fiamma, who uses electromagnetic waves not only for telegraphic messages, but for telemechanic writing, and the direction of movable objects, like ships at sea, motors on land, and flying machines. Signor Fiamma's invention is only in the rudimentary stage, but Italian naval officers are convinced that the invention is entirely new. Each machine is perfectly individual, and its waves cannot be interfered with. How isolation is achieved Signor Fiamma has not revealed, but it constitutes one of the principal features of his invention. Other experiments with submarine mines and the direction of torpedo craft have taken place lately, but they are kept secret by the Government.

An Investigation of the Grid Leak Circuit.

By N. WELLS, M.Sc.

THE purpose of this article is to sketch the internal working of the grid leak circuit and to show the fallacy of considering the resistance simply as a leak to the condenser. The latter occupies in effect a complementary position, acting as a buffer until the correct negative voltage is attained, after which its only function is that of a low reactance path for high-frequency signals.

The circuit includes the combination of a high value resistance and a small value condenser, such that, in the first case, a minute direct current calls for an appreciable drop in potential across the resistance, while in the second case a small accumulation of electricity causes an appreciable rise in voltage across the condenser. It will be shown that the former drop is the principal effect.

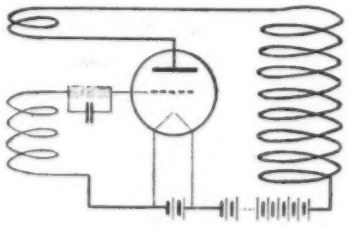


Fig. 1.

There are two distinct applications of the grid resistance, though the fundamental principle is identical:

(*a*) Transmitting—for maintaining the working point of a valve in correct position.

(*b*) Receiving—for causing a series of audio frequency grid displacements synchronous with the incoming signals; this is known as grid leak rectification.

Dealing with the first and more general case, and taking the layout of the circuit to be on the lines indicated by fig. 1, displacement of the grid potential to the correct bias depends on the simple fact that the grid current has a perfectly definite characteristic, and for the minute values here considered this characteristic has an appreciable excursion into the negative field. If we give to the grid some particular potential within this range, there is a definite, if minute, flow of current, completing its path through the circuit across the grid and filament. While generally such current is negligible, there is here a cumulative effect which becomes appreciable and useful; it is in fact an interesting example of a quantity whose magnitude is of the second order integrating into one of prime importance.

Owing to the curvature of its characteristic the grid current may be rectified. Starting with a steady and minute static current, we have then, immediately high frequency is applied to the grid, a rectified current superimposed upon the static current. Since the condenser is initially the path of lesser reactance, it is clear that the rectified current will accumulate there until a rising condenser potential causes an increase in the total current through the resistance; this flow will steadily mount until it finally reaches the combined value of the static plus rectified currents between grid and filament. Since at this point the currents coincide, there is no surplus flow into the condenser, which now simply acts as a by-pass for high-frequency oscillations. The increase of potential drop across the resistance is, of course, transferred to the grid, *which thus reaches the limit of its negative displacement.*

In order to maintain the grid potential steady at any required value, it is only necessary that the drop across the resistance should correspond to the requisite potential difference; in other words, the grid current determines the resistance. But the final grid current is difficult to compute, depending upon both the amount of rectified current and the static current at the point concerned, and in practice the resistance is inserted as a matter of experience, making due allowance for the fact that the final steady bias under working conditions is greater than the bias under static conditions. For example, if under running conditions it is desirable that the grid oscillate about a point with a negative bias of 100 volts, it may be necessary to insert a resistance such that when not oscillating the grid bias is minus 60 volts.

It is interesting to note in the foregoing that a steadily increasing grid negative tends to reduce the static current, and it is the addition of the rectified current which gives to the total a final higher value.

For power valves of any magnitude it is usual to interpose a permanent negative battery between filament lead and resistance; the object is to neutralise any chance tendency of the grid current to reverse, which would lead to high positive grid values and consequent disaster to the valve. Current reversal is known as blocking, and occurs if the anode voltage is too high or the grid mesh too wide.

The great superiority of resistance or potential-drop control over direct control by an independent battery lies in the automatic adjustment of the former to the changes, obvious or obscure, that occur almost continuously in a valve circuit under load. Any increase in current due to minor increases in supply voltage is countered by the corresponding increase in grid negative bias; again, a minor change in coupling is met by a corresponding variation in potential drop, following an increase or decrease in the rectified current. Incidentally, the latter is a point that is often not sufficiently appreciated when adjusting for coupling effect only.

It is probable that resistance control ensures easier starting, as the initial grid bias is more positive than when the circuit is oscillating.

Dealing now with rectification, from what has already been written it is clear that any train of incoming signals will displace the grid towards negative. Upon signals ceasing it follows that the grid returns or tends to return to its original position. We thus have for any series of incoming signals a series of grid excursions, and if the series is of audio frequency the grid will vibrate to that frequency. Now coming to the relations between grid and anode, if this movement of the grid occurs when the anode current is on the straight line portion of its characteristic, there will be an exact reproduction in the form of anode current variations, of dot and dash or speech sounds.

It remains then to adjust the circuit so that the straight line portion of the anode curve occurs when the grid is normal, and this can best be done in reception valves by applying a sufficiently high potential to the anode, thus permanently moving its curve to the left relative to grid potential.

The fact that resistance rectification often requires somewhat high anode voltage is perhaps its only disadvantage; what are the advantages?

Potential controlled rectification is confined to that small region of grid voltage values where the anode curve bends, and for this reason the grid bias is very critical. In the case of resistance rectification the locus of the grid may be anywhere along the straight portion of the anode curve. Again, relative to grid voltage the grid characteristic has a flat curve and the inherent grid rectification is not at all critical, so that, altogether, grid resistance rectification should be smoother, and less critical.

In Mr. L. B. Turner's excellent little treatise it is

shown also that, theoretically at least, leak rectification is more sensitive than simple rectification.

If a potentiometer having a range of six or eight volts range be interposed between the filament negative and leg of grid circuit, the working point may be shifted from the lower bend on the anode curve, through the straight, and finally on to the upper bend. It is interesting to observe in the first case how signals are weakened because the two systems of rectification are opposed; in the second, resistance rectification is normal, and in the third the two systems unite with louder, though somewhat distorted, effects.

In the case of reception valves fitted with the usual tungsten filaments, the curved portion of the grid characteristic extends, roughly, from 1 volt negative to 1 volt positive, the current through this range commencing perhaps at 0.5 and rising to 2.0 micro-amps. For dull emitter filaments the grid current curve is generally displaced about 1 volt towards positive. In some cases this may lead to the lower end of the grid circuit being preferably anchored at two or more volts positive, rather than at battery negative, and, generally speaking, it is well to appreciate that a difference exists between the grid characteristics of small valves.

A special application of grid resistance rectification occurs in those circuits employing a heterodyne as a means of transforming incoming short waves into relatively long waves. Sketching first, and very briefly, the system: Incoming waves are heterodyned so that an envelope results with beats recurring as the difference in periodicity between signal and heterodyne. If, now, one side of the envelope is cut off, the effect is no longer balanced, but undulatory, so that when applied to a circuit in tune with the recurring "humps" a wave of this frequency is set in motion. The obvious method of cutting off one side of the envelope is by subjecting it to the action of a rectifier which may take the form of a resistance-controlled valve (fig. 2).

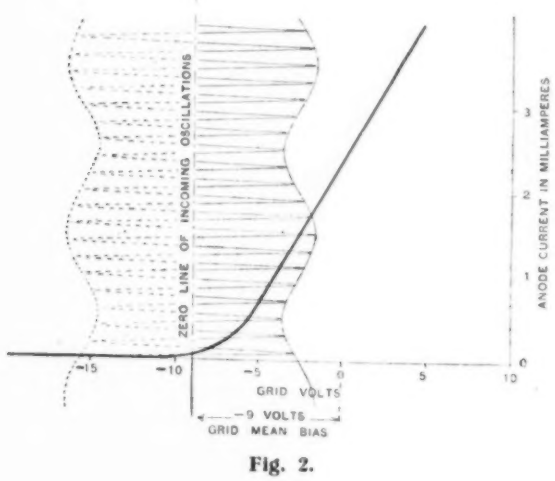


Fig. 2.

Here the heterodyned signals are subjected direct to the anode current curve, and the grid resistance in this case holds the grid at a sufficient bias to ensure that the envelope edge effect corresponds with the straight of the anode curve. It is to be remembered that the circuit is dealing with continuous high frequency, and not variable audio frequency, so the problem is really akin to that considered in the first part of this paper. Care must be exercised in choosing a resistance value sufficiently low, as if the value is too high the rectified grid current will swamp the useful peaks and carry the edge effect away back into a region of no reproduction whatever.

In order to ensure that the mean bias remains stationary and does not tend to vibrate in harmony with the envelope undulations, the shunted condenser may, with advantage, be of somewhat greater capacity than is usually employed in rectifier circuits.

Japanese Commerce and Industry.

A REPORT upon the commercial, industrial, and financial situation in Japan during the 18 months ended June 30th last has been prepared for the Department of Overseas Trade by Messrs. G. B. Sansom and W. J. Davies, respectively Acting Commercial Counsellor and Acting Commercial Secretary at the Tokio Embassy.*

The commencement of the report deals with the extent and effects of the calamitous earthquake which occurred in September, 1923, and with the measures taken by the Government and others to reconstruct the affected area and to alleviate the evils attendant upon the disaster. The Embassy and the Japanese Government archives were destroyed, which makes the report incomplete in a number of respects—principally statistical.

The balance of trade in 1923 was against Japan, the excess of imports amounting to 539 million yen (1 yen=approximately 2s.), but this large figure was due to a great extent to the abnormal situation during the later months of the year, which continued into the present year. It is to be noted, however, that with the exception of raw materials, imports in all groups declined from the 1922 figures. On the other hand, there was stagnation in the export trade, the total falling by 190 million yen. This general statement does not apply to insulated electric wire, which, valued at 7,818,000 yen, showed an increase of 6,209,000 yen, or to machinery and parts, which increased in value from 10,904,000 yen to 15,252,000 yen.

Finance and Prices.

The authors of the report state that one of the chief causes of the existing depression in trade is the high cost of commodities and service, and they venture the opinion that high wages are not so important a factor as the defects in organisation, the relative inefficiency of labour, and the exaggerated standard of profit which prevails throughout industry and commerce. A list of representative industries is given to illustrate this tendency, and this includes two electric power companies. It is shown how costly the raising of new capital has become by means of a list of issues of short-term bonds. The Daido Electric Power Co. has had to offer an actual return of 9.183 per cent., while the Tokio Electric Light Co. is giving an actual 8.629 per cent. on a recent 15,000,000-yen issue. The high rates of interest, combined with the low value of the yen, have led to the seeking of foreign capital. Several loans have been raised abroad by industrial undertakings, particularly electric power, light, and railway companies, and others are being discussed. There is certainly a profitable field for the investment of foreign capital in Japan.

Earthquake Damage.

In Part III of the report the authors revert to the earthquake in order to show in a more detailed manner its effect upon industry. As regards the electrical industry itself the account in our issue of October 24th, dealing with the Tokio Electric Light Co., covers the position pretty fully. The gasworks were not very seriously affected and soon recovered when the mains had been repaired. The damage to tramways and rolling stock in the affected districts was severe. The Tokio Municipal Tramways lost six power stations, a number of sheds and offices, and nearly 900 cars out of 1,900—a loss estimated at over three million pounds. The Yokohama tramway system was almost completely destroyed.

Taken altogether, says the report, the public utilities were restored with highly creditable speed, and at the date of the report (June) they had been restored to the extent of from 80 to 100 per cent. of their former efficiency. The outstanding exceptions were the telephone service, which was still disorganised, and the roads.

Only 10 per cent. of the factories in the Tokio and Kanagawa prefectures escaped all damage. Apart from silk filatures, 533 factories were entirely destroyed, 359 were partly destroyed, and a further 166 were slightly damaged. The classes of factories are not specified in the report.

British Firms in Yokohama.

The destruction of the city of Yokohama was almost complete in both business and residential quarters. This is one of the great centres in which British and other non-Japanese firms carry on an important business. The blow struck to British firms was very severe. They were at once bereft of their offices and records, warehouses, and stocks; their business was suspended and their staffs were homeless—to say nothing of the tragic death of many of their number. But it is happily possible to state that, though in many cases their financial losses were severe, they have, with a few minor exceptions, resumed their operations and appear to be gradually recovering their former position. With regard to future prospects, these must depend to some extent upon the progress of reconstruction and the general tendencies of trade. It is to be expected that Yokohama will in time regain in a large measure its former importance as a centre of operations for British and other foreign traders.

Machinery Imports.

In the absence of satisfactory statistics for 1923, it is only possible to say that machinery imports were of about the usual volume. Some orders for textile machinery from the

* Stationery Office, 2s. 6d. net.

United Kingdom were cancelled or postponed owing to earthquake losses suffered by firms, but this was doubtless only a temporary feature. In electrical machinery there has been, as before, strong competition between British and American manufacturers. In the supply of expensive machinery the question of finance is always important and, at present, when Japanese industries are seeking cheap money abroad, the firm which can give facilities to the Japanese buyer, either direct or by arranging a loan, is in an advantageous position. Perhaps even more important is the question of adequate technical representation. Only a technical representative on the spot can properly study the market, and get into touch, not only with the buyers of machinery, but with the works' engineers who use it. Japanese engineering has made rapid strides of late, particularly in certain electrical machinery and in internal combustion engines, but there is still a long way to go, and the demand for imported machinery, though its character may change, will remain important in the aggregate.

Railways.

The damage to railways caused by the earthquake, though limited to sections controlled by the Tokio Railway Bureau, embraced many miles of track, and included the destruction of stations, bridges, tunnels, and a large amount of rolling stock. Several power and transforming stations and warehouses were also destroyed. Reference was made in last year's report to the electrification of the main Tokaido line between Tokio and Kobe, to be completed by 1928. Although progress with this scheme has naturally been retarded a little by the catastrophe, the work is well advanced and it is expected that electric trains such as have been running since 1915 between Tokio and Yokohama, and also trains drawn by electric locomotives, will operate by the end of 1924 on the Yokohama-Ofuna-Yokosuka and the Ofuna-Kozu-Odawara sections. The intention is to carry out at the same time the electrification of the Akashi-Kobe and Kobe-Kyoto sections, but work on these portions has not yet begun. It is anticipated that by the end of 1926 the Tokio end of the line will have been extended beyond Kozu and Numazu.

In addition a much needed improvement is expected to be made by the end of 1924, *viz.*, the joining up of Tokio central station to Ueno, the starting-point for northern Japan. This will obviate the necessity for travellers from points west of Tokio to cross the city in order to entrain for places north of the capital.

Formosa and Dairen.

In the course of a report upon trade in Formosa by the British Consul at Tamsui (Mr. G. H. Phipps), which is appended to the main report, it is stated that the machinery imports consisted largely of supplies previously ordered by the Taiwan Electric Power Co. for its Lake Candidius scheme, now in a state of suspended animation.

Mr. E. L. S. Gordon, British Consul, states that the imports of electrical goods into Dairen during 1923 fell off by 4.6 per cent., and machinery and parts by as much as 51 per cent. The decreases were due to the earthquake, the building trade being especially affected.

The Electrical Exports of the United States.

Machinery and Apparatus.

BELOW are shown the values of electrical machinery and apparatus exported from the United States during the twelve months ended June last. Comparative figures for the twelve months ended June, 1923, are also stated and notes of increases or decreases added.

	12 months ended June, 1923. $	12 months ended June, 1924. $	Inc. or dec. $
Direct-current generators—			
Under 500 kilowatts ...	720,000	939,000	+ 219,000
500 kilowatts and over ...	1,116,000	704,000	− 412,000
Alternating-current generators—			
Under 2,000 kilowatts ...	179,000	146,000	− 33,000
2,000 kilowatts and over ...	1,671,000	1,195,000	− 476,000
Accessories and parts of generators	706,000	1,321,000	+ 615,000
Self-contained lighting outfits	600,000	652,000	+ 52,000
Batteries—			
Primary	1,168,000	608,000 (2)	—
Flashlight	—	476,000 (1)	—
Other primary	—	379,000 (1)	—
Storage	2,045,000	2,688,000	+ 643,000
Transforming or converting apparatus—			
Power transformers ...	3,438,000	3,937,000	+ 499,000
Other transformers	631,000	1,981,000	+1,350,000
Rectifiers, condensers, double current and motor generators, dynamotors, synchronous and other converters	1,238,000	1,075,000	− 163,000
Transmission and distribution apparatus—			
Switchboard panels, except telephone	2,475,000	2,069,000	− 406,000
Switches and circuit breakers over 10 amps.	1,898,000	2,138,000	+ 240,000
Fuses and fuse plugs ...	254,000	333,000	+ 79,000
Watt-hour and other measuring meters	429,000	659,000	+ 230,000
Volt, watt, and amperemeters, and other recording, indicating, and testing apparatus	945,000	1,204,000	+ 259,000
Lightning arresters, choke coils, reactors, and other protective devices	600,000	918,000	+ 318,000
Motors, starters, and controllers—			
Motors, under 1 h.p. ...	1,431,000	1,683,000	+ 252,000
Stationary motors—			
1 to 200 h.p.	2,366,000	3,155,000	+ 789,000
Over 200 h.p.	575,000	936,000	+ 361,000
Railway motors	552,000	1,483,000	+ 931,000
Electric locomotives—			
Railway	2,758,000	1,956,000	− 802,000
Mining and industrial ...	219,000	345,000	+ 126,000
Other motors	196,000	120,000 (2)	—
Rheostats, controllers, and other starting and controlling equipment ...	1,295,000	1,867,000	+ 572,000
Accessories and parts for motors	1,208,000	2,086,000	+ 878,000
Electric lamps—			
Carbon filament	59,000	66,000	+ 7,000
Metal filament	1,168,000	1,101,000	− 67,000
Other electric lamps ...	224,000	268,000	+ 44,000
Flashlights	394,000	629,000	+ 235,000
Searchlights and projectors	337,000	404,000	+ 67,000
Motor-driven household devices	807,000	889,000	+ 82,000
Electrical appliances—			
Electric fans	831,000	1,109,000	+ 278,000
Industrial electric furnaces and ovens	196,000	269,000	+ 73,000
Therapeutic apparatus, X-ray machines, galvanic and faradic batteries ...	725,000	989,000	+ 264,000
Signal and communication devices—			
Radio and wireless apparatus	2,945,000	4,062,000	+1,117,000
Telegraph apparatus ...	722,000	446,000	− 276,000
Telephone apparatus, including telephone switchboards	1,926,000	1,783,000	− 143,000
Railway signals, switches, and attachments	750,000	1,028,000	+ 278,000
Bells, buzzers, and annunciators	91,000	126,000	+ 35,000
Other electrical apparatus—			
Spark plugs, magnetos, and other ignition apparatus	1,196,000	2,127,000	+ 931,000
Insulating material ...	1,186,000	1,591,000	+ 405,000
Metal conduit, outlet, and switch boxes	355,000	547,000	+ 192,000
Sockets, lighting switches and receptacles	919,000	1,324,000	+ 405,000
Other wiring supplies and fixtures	1,738,000	955,000 (2)	—
Other electrical apparatus, n.e.s.	6,941,000	8,973,000	+2,032,000

(1) Jan. 1st to June 30th. (2) July 1st to December 31st.

Chinese Notes.—The *Chinese Economic Bulletin* records the following developments, &c.:—An electric lighting service has been commenced in Kaokiaochen (Kiangsu). At a new strawboard mill, which is being erected at Kashing (Chekiang), an electric power plant is being installed. The Chungking and Hankow telephone services are being extended. China has been invited to send delegates to the International Telegraph Conference which is being held in Paris next spring. The Chinese Electric Power Co., Ltd., recently invited tenders for the supply of 12 tramcars for its Nantao-Shanghai extensions.

A Large Natural Gas Plant.—The *Electrical World* states that the Louisiana Power and Light Co. is about to commence the construction of a 100,000-h.p. electric power station in North Louisiana to generate electricity by the use of natural gas. The generating plant will comprise five 20,000-h.p. Westinghouse turbo-generators. The power which will be derived from this station has already been contracted for. The cost of the station is estimated at $7,500,000.

An Electric Harmonic Analyser.

By J. D. COCKCROFT, R. T. COE, and J. A. TYACKE (Students I.E.E.), and Prof. MILES WALKER, M.I.E.E.

(*Abstract of Paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

THIS paper deals with the experimental harmonic analysis of e.m.f. and current wave-forms.

Prior to the method outlined, this was carried out by two classes of methods. The first class consists of "indirect" methods, in which the analysis is carried out in two distinct stages. The wave-form of the supply being analysed is first determined, so that the relation $e = F(t)$ can be expressed graphically, where $F(t)$ is any one-valued periodic function of time satisfying very general conditions; this wave-form is then analysed by one of the usual methods of approximate harmonic analysis. Various methods of determining the wave-form exist; they depend generally on the Joubert contact principle or the oscillograph. In all these methods the duration of the impulse on the measuring instrument has to be

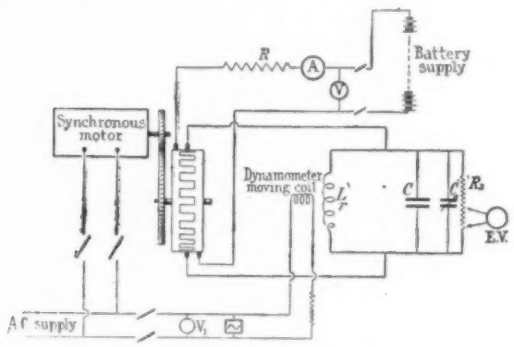
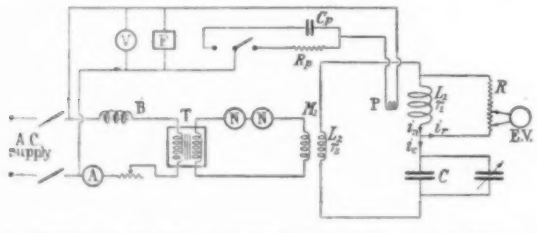


Fig. 1.—Commutator Method of Excitation.

made very small to obtain accurate values of the instantaneous e.m.f., and the sensitivity of the instruments used is therefore much reduced and errors may be large.

Three "direct" methods are discussed in the paper. Resonance methods consist generally in applying the e.m.f. under analysis to a circuit containing a choke coil and a condenser in series. By tuning the circuit so that resonance occurs with any particular harmonic, and measuring the voltage either across the choke coil or condenser, the value of the harmonic to whose frequency the circuit is tuned may be calculated if the constants of the circuits are known. This method involves errors due to the influence of other harmonics, and the use of a choking coil with a very low damping factor to counteract this leads to difficulty in obtaining accurate readings for the peak values of current; other errors are caused by eddy-current and hysteresis losses. The rectifying methods perform the summation of a series of expressions, involving the instantaneous values of current and the periods of waves, mechanically by means of a synchronously-driven commutator. These methods are very laborious. In the third

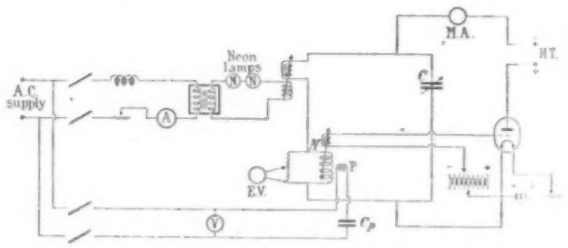


B, adjustable choke coil; T, saturated transformer; N, neon lamp; M_1, air-core mutual inductance; F, pressure coil of dynamometer; C_P, small-capacity condenser (0.1 mF); R_P, non-inductive resistance (1,000 ohms); F, frequency meter; EV, electrostatic voltmeter.

Fig. 2.—Neon-lamp Method of Analysis.

"direct" method the a.c. potentiometer is employed. If the phase of one of the currents in the potentiometer circuit be shifted by 120 deg. from the phase giving no deflection in the vibration galvanometer, a current will flow, due to all the harmonics except the 3rd, 9th, 15th, &c., assuming the even harmonics to be negligible. Similarly, by shifting the phase 72 deg., the harmonics of the order $5n$ will produce no effect. Hence, by taking a number of readings with different settings of the phase shifter, it is possible to establish a series of equations with the amplitudes of the harmonics as unknown, and on solving these to determine these amplitudes. This method is not very accurate, and, above the 13th harmonic, very cumbersome.

The simplest direct method, from the theoretical point of view, is the dynamometer method. In this the current to be analysed, or a current proportional to the e.m.f., if an e.m.f. wave is to be dealt with, is passed through one coil of a dynamometer, whilst an "analysing" sinusoidal current of the frequency of the harmonic to be found is passed through the other coil. The difficulty in practice is to obtain a perfectly sinusoidal current of suitable frequency. The error due to this is discussed at some length, and the principal modification in the dynamometer method of analysis introduced in the paper consists in the application of the selective properties of an oscillatory circuit to obtain a sinusoidal current. The first method which was developed for producing the forced oscillations of the desired range of frequency was to use a 46-part commutator driven at some fraction of the fundamental frequency by a synchronous motor and gear wheels. The outer rings of the commutator were connected to a d.c. supply, and the circuit in use was connected to the segments by a pair of brushes. The arrangement is illustrated in fig. 1. The wave-form of the applied e.m.f. is then rectangular or trapezoidal in shape. A ring-wound two-pole d.c. motor was adapted for use as a synchronous motor and was satisfactory, apart from a tendency to phase-swing. The main considerations governing the design of the oscillatory circuit were:—(i) The ratio of effective resistance to self-induction (r/L) had not to be much greater than 15; and (ii) the circuit had to be capable of oscillating at all frequencies from 30 to 1,100 cycles per second. The choke coil was therefore arranged for a minimum self-induction of 0.004 henry and to enable simple multiples of this to be obtained; a ratio of resistance to self-induction of the order of 10 (measured with d.c.); and as low as possible a ratio of effective resistance at 1,100 cycles to resistance measured with d.c. The large capacity C in the circuit was sub-divided into steps of 40, 20, 20, 10, 5, and 5 mF, giving a total of 100 mF, and was suitable for continuous working at 100 V. The small tuning condenser covered a range of from 0.1 to 8.0 mF in convenient steps. To eliminate the losses inevitable with the use of a separate dynamometer



MA, milliammeter; EV, electrostatic voltmeter.

Fig. 3.—Diagram of Circuit used in Tests.

instrument, the choke coil was so designed that it could be used as the fixed coil of the dynamometer. A moving coil with a bifilar suspension was placed inside the fixed coil, the magnetic axes of the two coils being at right angles. The small deflection of the moving coil necessitated the use of an optical measuring system.

In making an analysis of a voltage wave-form, the brush gear on the commutator is first adjusted so that the inner brushes are in exactly corresponding positions on oppositely-connected segments of the commutator. The outer brushes are connected to a battery supply giving up to 250 V, a non-inductive resistance being connected between the battery and commutator. The gear wheels necessary for the particular harmonic under measurement are fitted and the motor run up to speed and synchronised with the machine or supply whose wave-form is to be analysed. The value of capacity required is calculated, the supply switch closed, and the oscillatory circuit tuned to give approximately a maximum reading on the electrostatic voltmeter. The moving coil circuit is closed and the brush rocker on the commutator moved until a maximum reading is obtained on the dynamometer scale. Before taking a final reading, the tuning of the oscillatory circuit is adjusted to the exact resonance point. The r.m.s. voltage of the supply is read by an ordinary precision voltmeter, and the frequency determined by a frequency meter or tachometer. The ampere-turns of the fixed coil are calculated from the reading of the electrostatic voltmeter, and the amplitudes of the harmonics are then determined from (5 *f*). Details are given of a number of tests on the completed apparatus.

The second method of analysis was evolved from the method described by two important modifications. To avoid the necessity of inducing in the oscillatory circuit an e.m.f. wave

of different frequency for each harmonic to be found, the oscillatory circuit was tuned to the various harmonics in a single e.m.f. wave of a suitable form. In the second place, to avoid introducing the inherent drawbacks of a commutator and the need for a separate d.c. supply of energy, this special e.m.f. wave was obtained from the a.c. supply being analysed by the use of a saturated transformer and neon lamps. As shown in fig. 2, the primary of the transformer is connected to the a.c. supply through a choke coil such that the current is maintained almost sinusoidal, and saturation takes place early in each half-cycle. The secondary circuit of the transformer is completed through several neon lamps, and the primary of an air-core coupling with the oscillatory circuit. The characteristic of the neon lamp enables only the sharp peaks of the secondary e.m.f. wave from the transformer to be used, and thereby the magnitude of the fundamental in the current wave is kept to a minimum. The d.c. characteristic of the neon lamp is such that a definite e.m.f. (e)

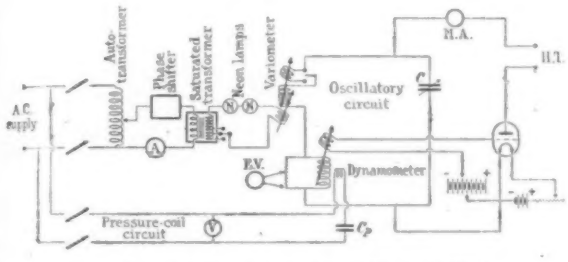


Fig. 4.—Circuit for complete method of Analysis.

is required to start the current in either direction. For an applied e.m.f. less than e there is no current, while for a greater e.m.f. the lamp behaves as a large non-inductive resistance where the effective e.m.f. is equal to the applied e.m.f. minus the starting e.m.f. e. This gives practically a straight-line characteristic, neglecting a small hysteresis effect. In actual lamps the effective resistance is different for the two directions of current, and they are therefore used in pairs "back-to-back." The starting e.m.f. is about 160 V per lamp, so that the maximum e.m.f. from the transformer may have to exceed 1,500 V if four lamps are used in series. In the analysis of an e.m.f. wave the number of lamps used in the secondary circuit of the transformer must be such that the maximum harmonic in the e.m.f. wave induced in the oscillatory circuit is about the 11th or 13th. The oscillatory circuit is tuned to the harmonic in the induced e.m.f. of the same order as that to be found in the wave under analysis, the electrostatic voltmeter giving a maximum reading when the circuit is exactly tuned. The magnitude of the harmonic is found from the resonating voltage and the reading of the dynamometer. The different of phase $\phi_n - \phi'_n$ of the nth harmonic currents in the two coils of the dynamometer may be eliminated by adjusting the phase of the current in the primary circuit of the transformer until the dynamometer reading is a maximum (a non-inductive resistance being in series with the pressure coil), or by taking two readings of the dynamometer with a non-inductive resistance and a small-capacity condenser, respectively, in series with the pressure coil. The latter method was used in the tests, but in the final method of analysis adopted the phase-changing method is recommended.

The accuracy of the neon-lamp method of analysis can be increased considerably by the use of a 3-electrode valve circuit, which can be made to act as a negative resistance. At the same time, as the oscillating circuit can be designed for a much larger r/L than was before possible for the required accuracy, the whole apparatus can be made portable. Section 7 of the paper is devoted to this aspect of the question; fig. 3 illustrates the circuit used in the tests. The valve used is of a standard type with a saturation current of not less than about 40 ma, and the procedure to be followed is detailed.

The final section of the paper deals with the possibility of obtaining the analysing current from a valve generator without the neon-lamp coupling. It is shown that the self-oscillatory method is capable of giving accurate results where the frequency of the a.c. is sufficiently steady to permit of its use. As this method cannot be of general application, however, the most useful method to meet general requirements will be a combination of this method with the neon-lamp method. The valve used will in the one case supply the necessary oscillatory current, and in the other amplify the current induced by the neon-lamp circuit. The combination of the two methods can be very simply effected, since it is only necessary to modify the apparatus of the neon-lamp method with valve amplification to the extent of ensuring that the damping of the moving system of the dynamometer is properly adjusted, and to provide means for that very fine tuning which is essential to the self-oscillatory method. This is effected by using a small variometer in the final stage of the tuning, this consisting of a small coil in series with the main inductance used for the neon-lamp coupling, and capable of being rotated in it at the opposite end to the coil carrying the neon-lamp current. The complete diagram of connections is given in fig. 4.

Discussion in London.

Prof. Miles Walker read the above paper at an ordinary meeting of the Institution in London on November 6th, and subsequently, with his assistants, demonstrated the apparatus described. By means of a spot of light on a long scale he first showed the amplitude of the fundamental of the e.m.f. from a triode valve, and, keeping the analysing current constant, went on to deal with the 3rd, 5th, 7th, 9th, and 11th harmonics, registering their amplitudes on the same scale. Then, by means of an oscillograph, he demonstrated the wave forms of the same fundamental and harmonics.

Dr. C. V. Drysdale was the only speaker. He said that the subject of harmonic analysis was of increasing interest and importance, and he thought that the author's methods would supersede the others mentioned in the paper, which were far inferior in accuracy and ease of performance. He considered, however, that the method of reading the wave-forms might be simplified. Too much was thought of the dynamometer; the electrostatic and hot-wire methods had much to commend them. The periodic time of the dynamometer was large, and the currents had to be kept constant in phase relation for quite considerable periods. He considered that the string electrometer method was better, and by means of slides he explained an arrangement employing this which he and his assistants had developed. This apparatus closely followed all variations; it was not a knowledge of the phase relations which was required, but the magnitude of the harmonics. After all the main idea was not only to find faults in wave-forms, but to eliminate them. He had recently designed an alternator on the lines of his phase-shifting transformer, in which the windings were distributed in accordance with a sine law. An illustration of the wave-form obtained from a 40-W machine of this type showed a pure sine wave with only a very slight "tooth ripple."

Prof. Miles Walker, in reply, said that the authors realised that with an instrument which followed variations very quickly, harmonics could be measured much more expeditiously. Referring to his own apparatus, he said that if the frequency was reasonably steady, harmonics could be measured without the use of neon lamps. The results from Dr. Drysdale's machine were excellent, but the tooth ripple was very difficult to eliminate.

The President (Mr. W. B. Woodhouse) said that it was pleasant to receive such a contribution from the younger members; he hoped that the Institution would receive further communications from them.

Tramway Employés' Wages.

The special Tribunal appointed in July to consider the questions of wages and conditions in the tramway industry has now issued its report and decision.* Notes of the proceedings at the meetings of the Tribunal appeared in our issues of August 1st and 8th (pp. 179 and 235). The chairman was Sir William Mackenzie, K.B.E., K.C., and the 14 members were equally divided between the two parties in the case. The employés asked for the fixing of standard rates of wages in accordance with four groups; for an increase of 10 per cent. to be made in the maximum for each grade in each group; the limiting of variations between minima and maxima; the stabilisation of the new rates for a definite period; and for the payment of "time and a quarter" for all night work. There was a proviso that the minimum rate for any worker should be 52s. for a normal week of 48 hours. It was claimed that the granting of these requests would remove anomalies, and would provide the workers with the better standard of living to which they were entitled; it was claimed that the rates were not exorbitant and were within the capacity of the industry to pay.

The employers' side agreed that, theoretically, grouping had its advantages, but it was pointed out that all negotiations to this end would be fruitless on account of the practical difficulties and as the employés would not agree to standardisation by grouping unless it was accompanied by an increase in wages. Examples were given of the difficulties referred to, and, with regard to the increase in wages, it was shown that the employés' present rates took full account of the increased cost of living and were higher than those of the classes from which tramway employés were recruited. The principal ground of resistance, however, was the present and prospective financial condition of the undertakings. The extra burden involved in the application could only be met by the doubtful expedient of increased fares, or, in the case of municipal undertakings, recourse to the rates, where this was permissible. Any increase of fares at the present time was considered likely to result in reduced revenue. The employers stated that they would agree to the stabilisation of the present rates for a short period if the Tribunal thought that this was desirable. They also agreed with the principle that men working at night should receive more than day workers but said that the industry was unable to bear the extra expense.

In its decision the Tribunal states that it has found it convenient to classify the tramway undertakings in six groups. There are two further groups with which the Tribunal is

* The Tribunal, 5, Old Palace Yard, S.W.1. Price 6d.

unable to deal owing to special conditions. The first of these two groups consists of Belfast, Hull, and Leicester, and it is recommended that the present rates remain unaltered except for their adjustment to the nearest sixpence. The other group is left to the consideration of the National Joint Industrial Council. The remainder of the undertakings are placed in six groups which are governed by the following conditions:—(*a*) No employé shall suffer a reduction of wages; (*b*) No employé shall receive a weekly increase in wages of more than 1s. 6d.; and (*c*) The present rates shall be calculated to the nearest sixpence.

A series of schedules are attached to the report in which the undertakings are grouped, and commencing the maximum weekly rates are given for motormen, conductors, car cleaners, and semi- and non-skilled men at depôts and running sheds. Other classes of employés are not dealt with; it is left for the National Council to make decisions in such cases. The Tribunal recommends that the employers of any undertaking or the representatives of employés in that undertaking shall have the right of appeal to the National Council with a view to re-classification. It is also recommended that the decision and report should come into force as from the date of expiry of the National Agreement of September 28th, 1922, and shall remain in force, subject to three months' notice by either side of the Council, and that no notice shall be given before December 31st, 1925. With regard to night work, the Tribunal recommends additional payment of 4s. per week outside the Metropolitan area and 6s. per week within it, but that this should not come into force until January 1st, 1925. Where additional rates are already being paid these will form part of the 4s. or 6s. as the case may be. The rates set out are for adult male employés (21 years and upwards) performing the ordinary and customary duties of their class.

Studying the details of the settlement it is seen that for motormen the commencing and maximum rates respectively range from 60s. 6d. and 63s. 6d. in Group I to 50s. 6d. and 53s. 6d. in Group VI, in two-shilling steps. For conductors the rates vary from 56s. 6d. and 59s. 6d. to 48s. and 49s. 6d. Car cleaners are given a flat rate of 56s. in Group I falling to 52s. in Group VI. Employés in depôts and running sheds are placed in three grades according to the nature of their duties. The rates in Group 1 are 63s. 6d., 59s. 6d., and 56s., for Grades I, II, and III respectively; in Group VI the equivalent rates are 56s. 6d., 54s. 6d., and 52s.

Larner-Johnson Hydraulic Valves.

Extensions at Lake Coleridge, New Zealand.

In connection with the extension of the Lake Coleridge, New Zealand, hydro-electric power scheme, Messrs. J. Blakeborough & Sons, Ltd., of Brighouse, Yorks., have received an order for a complete set of head gates as follows:—Two 10-ft. by 5-ft. and one 8-ft. by 6-ft. motor-operated tunnel gates; one 4-ft. 6-in. by 2-ft. 6-in. hand-operated surge tank gate; and three 7-ft. diameter motor-operated gates for pipe intakes, each being provided with an automatic tripping device.

The last-named mechanism is designed to ensure the automatic closing of the gate in the event of the velocity of the water in the penstock exceeding a predetermined value due to either a turbine runaway, or a burst penstock or turbine casing. It consists essentially of a paddle placed in the penstock, so that when subjected to the pressure due to the increased velocity the paddle is forced in the direction of the flow and throws over a switch which puts in circuit a solenoid operating a clutch that releases the operating gear and allows the gate to run down under its own weight. The gates are of the slider type, consisting of cast-iron doors, guide frames with gunmetal faces, and mild-steel lifting rods and overhead gearing, all of them being arranged for hand operation in case of emergency.

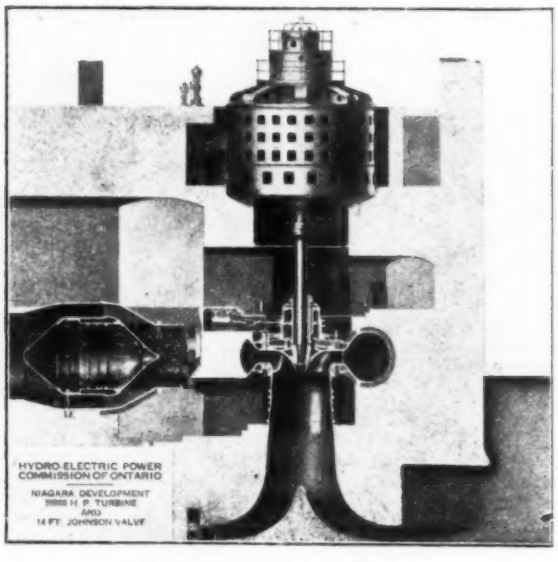


Fig. 1.—A 14-ft. Valve at Niagara.

Messrs. Blakeborough have also received an order (through Messrs. Vickers, Ltd., of Barrow-in-Furness), for two Larner-Johnson valves, each of 4 ft. 6 in. diameter, to operate under a head of 536.5 ft. and feed turbines of 12,650 h.p. of the spiral casing Francis type; the valves are fitted with the "T" type of control to ensure their operation at part openings without the plunger having a tendency to creep, and also to provide for the automatic closing of the valve in the event of a turbine runaway or burst casing.

The Johnson valve was first introduced for commercial use in water-power plant in 1910, applying the needle valve principle to the control of water flow in pipe lines and conduit. Where penstock valves are required, it is in use in practically all of the largest hydro-electric plant; in fact, it is claimed that the largest valves in the world are of this pattern, the design of which enables it to be built in mammoth sizes. The location of a 14-ft. valve in relation to the turbo-generator is indicated in fig. 1, which shows a 55,000-h.p. machine at Niagara (Hydro-Electric Power Commission of Ontario), while fig. 2 is a view of the largest valve in Canada, 20 ft. in diameter, 140-ft. head (Shawinigan Water & Power Co.). Messrs. Blakeborough have acquired exclusive manufacturing and selling rights throughout the world, except for the U.S.A. and Canada, whilst the services of Mr. C. W. Larner, of the Larner Engineering Co., Philadelphia, have also been retained by them.

In general the valve consists of a circular body surrounding an internal cylinder, closed at one end and connected to the body by radial ribs, in which a needle plunger operates and makes contact with a seat in the neck of the body to close the valve; the pipe line pressure in the body of the valve itself is utilised to move the plunger. The improved type "E" (fig. 3) is provided with a double-acting (instead of a single) pilot valve, which consists of a tubular stem 1 with a head 2 containing ports 3 turned backward, the discharge from which is controlled by the movement of the head in respect to the end of the guide 4. An additional chamber 5 at the inlet end of the valve is effectually separated from chamber A by a partition 6 which fits closely around the stem 1. Pipe-line pressure is admitted to chamber 5 through ports 7 of ample area to admit the maximum flow required without appreciable loss of pressure; these ports act as a strainer to exclude foreign matter from chamber 5. All water admitted to chamber A must enter through the tubular stem 1. This

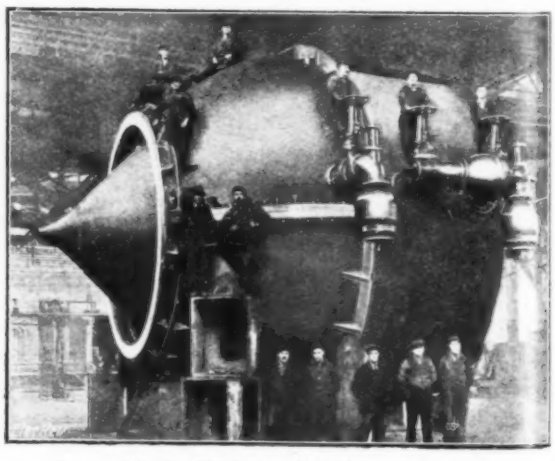


Fig. 2.—The Largest Valve in Canada.

pressure supply is automatically reduced and finally cut off entirely as port 8 is progressively opened; conversely, the pressure supply is increased as the exhaust through port 8 is diminished. Thus the operating pressure in A is much more positively controlled than it is in other types which never interrupt the admission pressure to A.

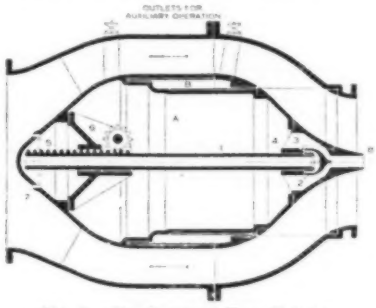


Fig. 3.—The Improved Type E Valve.

The Larner-Johnson valve may be adapted for shutting-off or emergency closing power house penstocks, or a storage reservoir discharge regulator, as a relief valve for preventing excessive shock or water hammer, as a combined stop and check valve, and for waterworks, &c., but it is not advocated for service which would permit the valve to remain idle long enough for encrustation and corrosion to take place on the sliding surfaces; the latter are never under pressure.

The flow through the valve at all positions of the plunger is smooth and free from eddies; the hydraulic characteristics of flow are identical with those of the needle nozzle of an impulse wheel, and the valve is equally free from vibration. All parts are circular and hence free from distortion under high pressures and the stresses can be accurately determined; thus it is possible to build this valve in sizes larger than could be attempted with any other type. They are in use and under construction up to 21 ft. diameter. Some of the larger valves operate under heads up to 1,000 ft., while smaller ones have been tested under pressures up to 3,000 ft., and the makers claim that so far they have never furnished a new part of any kind to replace one worn out in service.

Electricity Supply.

Abstract of Chairman's Address; I.E.E., North-Western Centre.

MR. H. C. LAMB, deputy chief engineer of the Manchester Corporation Electricity Department, delivered his address as chairman of the North-Western Centre of the Institution of Electrical Engineers at Manchester on November 4th, in the course of which he said, *inter alia*:—

We meet again at a time when there are some good reasons, I think, to be hopeful about the near future of the electrical industry. While trade is still seriously depressed, signs of an improvement are not wanting. One such sign, of some local interest, perhaps, is that the combined electric power consumption of the 100 largest industrial works using the public supply in Manchester has shown a gradual but continuous rise, month by month, until it is now substantially greater than it was two years ago. Another is that public opinion has become decidedly more convinced that one of the chief needs of to-day is a greater application of electrical power to the business of life in all its branches; the encouraging thing is that writers in the popular Press are now emphasising this point, and the necessity for a national policy with regard to the development of the electricity supply industry is generally realised. At the present rate of growth, the output of the public supply works in the chief towns will double itself in four or five years—a rate of advance which, in any other industry, would give cause for immense satisfaction, but as ours is expected to grow at a phenomenal pace, something better is demanded. As the fuel cost is 75 per cent. of the total operating cost of a modern power station, generation by water power has a considerable influence on selling price. While the flat rates for lighting are, on the whole, lower in America than in this country, the rates for power are practically on the same level. As regards the industrial power section, it is a fact that the most advanced British municipalities and power companies have secured as great a proportion of the potential demand as have similar undertakings anywhere else, although, of course, there are still vast possibilities in this direction.

It is in the development of the domestic service load that we are behindhand, in spite of the fact that there does not appear to be anything in America so favourable to the consumer as are the two-part tariffs in common use in this country, with a fixed charge based on the ratable value of the house, plus a low rate for energy consumed: and yet the number of domestic consumers in British towns is only a small fraction of what it should be. In the Manchester area, for instance, electricity is used in 10,000 dwelling houses, which is only 5 per cent. of the whole number and probably typical of our towns generally. In the most progressive towns in America a supply is given to 80 per cent., or even more, of the houses and it must be admitted that this difference is chiefly due to the much greater enterprise shown there.

The problem in America was solved by the adoption of a deferred payment system for wiring and fittings, financed in some cases by the supply companies themselves, in others by banks working in conjunction with associations of wiring contractors. The tariffs in force in almost all English towns to-day are sufficiently attractive to ensure that practically all new houses of any class are wired for the use of electricity, but it seems impossible to secure the old houses in any great numbers without some scheme of free or assisted wiring.

In the same way it is the first cost of electrical apparatus which prevents its use by the general public. For example, until one year ago only 100 electric cookers were purchased and installed by consumers on the Manchester mains, whereas in the first year of a public hiring scheme 500 were connected. One great advantage of public hiring and maintenance schemes is that the experience gained rapidly leads to improvements in design; the records of failures show the general weaknesses, and make it possible to specify features essential to success. If rapid progress is to be made, it would appear that more apparatus must find its way from the manufacturer to the consumer through the supply authorities. This method inspires confidence, because the consumer knows that untried and untested articles will not be recommended to him, and that, in case of accidents, satisfactory repairs will be carried out at a reasonable cost. If this service were developed in Manchester to the same degree as in the most advanced towns elsewhere, it would require the whole of the plant now installed at the Barton power station to deal with it.

In recent years there has been a marked raising of the standard of desirable illumination. The following may be regarded as desirable values of the minimum illumination on the horizontal plane at ground level, midway between lamps:

For important street crossings and public squares, &c., in cities where traffic is dense—0.5 to 1 foot-candle, or more.

For important main thoroughfares—0.3 to 0.5 foot-candle, or more.

For secondary thoroughfares—0.1 foot-candle.

For side streets and streets in residential districts—0.05 foot-candle.

Some of these values will eventually be exceeded, and as an "all-night" street-lighting load has a load factor of well over 40 per cent., it is a very desirable one, and more particularly so in the case of residential districts. The only disadvantage is that it is essentially a peak load, but the importance of this distinction is rapidly disappearing. Depending upon the standard of illumination adopted, the load will vary from 5 to 25 watts per yard of street.

The "Super-Power" Station.

The "super-power" stations erected in the last few years have fully realised the high expectations of those responsible for them. They contain some of the finest products of British engineering, and are operated in a manner unsurpassed anywhere as regards the care which is taken to secure the highest working efficiency. They attract a constant stream of engineering visitors from all over the world, and the high thermal efficiencies predicted, the economy of labour, and low working costs, have all been realised.

We have to look to higher steam pressures with inter-stage reheating for future gains in economy. The stations now operating at 375 lb. steam pressure have a coal consumption per kilowatt-hour which is about one-half of what was usual 20 years ago. A further gain of 8 per cent. can be made by raising the initial pressure to 550 lb. per sq. in., and re-heating the steam once, and if the pressure were raised to 1,200 lb. per sq. in., and the steam re-heated twice, it is estimated that 20 per cent. would be saved, making it possible to obtain station overall thermal efficiencies of 26 per cent. when using very large units. Plant of this kind, of course, means high capital cost and its justification will depend on the future price of fuel. The remarkable example of modern turbine construction, shipped from the Tyne to America a few months ago, has a guaranteed consumption of approximately 6½ lb. of steam per kilowatt-hour. Boilers have been ordered for a working pressure of 1,200 lb. per sq. in.—not small experimental units, but designed on the scale common in big power stations to-day, having steam and water drums of forged steel with walls 4 in. thick. To work in conjunction with the Rugby "Benson" boiler, which jumps to the "critical pressure" of 3,200 lb. per sq. in., turbo-plant has been completed, and the results of the tests which are now in progress will be awaited with much interest.

It may be that the use of very high steam pressures will cause the present construction of tubes, combined with steam and water drum, to be abandoned. It has been suggested that the drum be dispensed with, and provision made for fluctuations in load by the use of a water-steam accumulator

working in parallel on the low-pressure stages. The accumulator would be charged with steam from the high-pressure turbine when the load fell below the average, and would yield its steam through a re-heater to the low-pressure turbine as the load increased.

Experience shows that very little priming takes place so long as proper care is given to the condition of the feed water. The closed feed water system can be entirely successful, but only if great care is exercised. A tight surface condenser working under high vacuum is an efficient deaerator, provided that the make-up water is injected in a fine stream. Under these conditions, the amount of dissolved oxygen present when the condensate leaves the condenser can be as low as 0.07 c.c. per litre, which small proportion is probably harmless. However, the ordinary type of condenser extraction pump is unsuitable for a closed system, and unless a sharp watch is kept the good work of deaeration which has been done in the condenser is entirely neutralised by the admission of air at the pump shaft glands.

It is therefore desirable that pumps intended for this work should be designed with the shaft glands on the discharge (or pressure) side, thus removing one source of danger.

A recent improvement, which should always be installed in combination with soot blowers when solid fuel is used, is the cinder catcher. They can now be obtained to eliminate 90 per cent. of the solid stuff from the chimney gases. Another new feature in the boiler house is the air pre-heater. The important point in their operation is that the gases should never be cooled down to so low a temperature that deposition of moisture takes place, because corrosive substances readily attack ordinary mild steel in the presence of moisture. It is doubtful whether an air temperature of 350 deg. F. will be economical, as it will certainly cause increased furnace maintenance costs, but at moderate temperatures (such as 200 deg. F.) air pre-heating has been an unqualified success.

Super-Pressure Cables.

Interest was undoubtedly stimulated by the announcement of Government intentions to use the powers of the State for the purpose of furthering a scheme of new transmission lines, and one may perhaps be permitted to hope that recent events will not cause a reversal of that policy.

The chief claim on behalf of single-core cable is one which must appeal strongly to all those who have responsibility for maintaining the continuity of supply in large electrical systems. I refer to the claim that, as the insulation of the conductors is subject only to the dielectric stress between phases and the earthed neutral, the automatic protective gear will be called upon to deal solely with faults to earth. It has been the custom to think of high-pressure cables as never breaking down, except through faults having an external origin. For the higher voltages now coming into use this no longer holds good, and the shock of a short circuit at a pressure of 33,000 volts, or more, even when the fault is several miles from the generating plant, is a very severe one. The claim, therefore, that short circuits would be eliminated by the use of single-core cable merits the fullest consideration.

It should be remembered, however, that two simultaneous earth faults on different phases are quite a possibility, and amount to much the same thing as a short circuit, and it has been found in practice that, unless great care is exercised, the damage caused by a fault on a single-core system is not confined to the area in which it originated.

It may be that capital charges and eddy current losses will fix a minimum pressure for the commercial use of single-core cable, and that manufacturing difficulties will fix a maximum for multicore cable; these two limiting figures will not be very far apart, possibly in the neighbourhood of 50,000 volts.

The 33,000-volt underground line connecting Manchester and Salford was not quite the first example of the kind, although it was the first in Great Britain. It has been in continuous use for five years, so far without a black mark of any sort on its record. Since then, over 60 miles of cable for this pressure has been laid in Manchester and the immediate neighbourhood.

A certain amount of trouble has been experienced, both with joints and cables, at voltages above 30,000, and it has been necessary in some instances, alike in this country, in Europe, and in America, to make temporary reductions in working pressures. This applies both to single and multicore systems.

However, practically all manufacturers and users are convinced that the reduction in working voltage is only a temporary measure, pending certain alterations; in some of these cases the normal pressure has already been restored. Trouble has been due to various causes. In the first place, main transmission lines have often to be laid very deep in the ground, which increases the difficulty of keeping water out of the joints. With regard to breakdowns of the cable itself, a striking point is that very slight changes in manufacture appear to make all the difference between failure and success. The absolute exclusion of air, the removal of the last trace of free moisture from the materials, and tightness of the dielectric, are essential to success. It would appear that changes of temperature, following the rise and fall of the load, cause movement of moisture and of the impregnating oils which may result in breakdown, even after the cable has withstood a test far more severe than the normal working pressure.

Owing to the relatively large proportion of dielectric, super-pressure cables are somewhat weak mechanically, and require much more careful handling and laying than those for ordinary pressures. It has even been suggested that the cable should be manufactured in straight lengths, and not coiled on to drums, but that is going to extremes. Electrically, the unbalanced static potentials existent in the usual 3-core formation would appear to present a more difficult problem than the maximum potential gradient on the layers of dielectric immediately adjacent to the conductors.

With voltages over 30,000, breakdowns have been due to short circuits between two cores, and, in spite of the quick operation of protective gear, it has not always been possible to isolate the faulty feeder with sufficient rapidity to prevent a serious disturbance of the whole system concerned. In protective apparatus there is still room for improvement; much of the trouble has been caused by the weak mechanical construction of the relays, and another point not sufficiently appreciated is the extent and effect of the comparatively heavy capacity currents in 33,000-volt mains, and, consequently, gear of the highest repute has failed to retain its stability under the conditions arising from a severe system disturbance.

New Electrical Devices, Fittings, and Plant.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A New Vehicle Battery.

THE ACE BATTERY CO., LTD., Crescent Works, Lutterworth, is marketing a lead battery (fig. 1) of the flat-plate type for vehicles, made to the standard sizes and incorporating the firm's special "lattice" separator (provisional patent No. 6,332/24), which consists of a closely-woven wood sheet. This sheet is laid flat against the positive plate and, in conjunction with a thin wood veneer which is placed against the negative plate, forms a complete combined separator. The woven wood lying flat against the positive plate prevents the disintegration of the fine particles of peroxide, yet, by virtue of the small crevices in the weaving of the sheet, free circulation of acid and space for the evolution of gas bubbles are provided for. The whole of the separator is a natural material, chemically treated to remove all resins and impurities, which results in a more cellular material, and no bonding agent is employed which would only produce impurities in the cells. With this separation a high capacity is obtained in a small space.

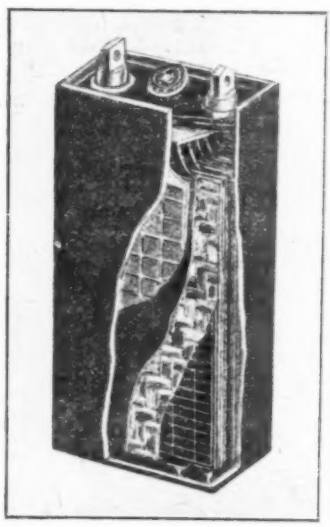


Fig. 1.—The "Ace" Vehicle Battery.

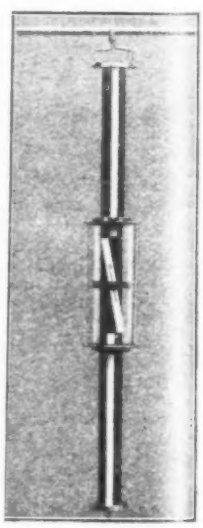


Fig. 2.—An Electrostatic Potential Indicator.

The company is producing house-lighting batteries on similar lines, the only difference being that there are varying sizes of plates with the lugs suitably arranged, and the cell is bound round with ebonite bands and placed bodily into the glass jars. The motor-car lighting and starting batteries and wireless and portable batteries which the company is to produce are on more or less standard lines.

An Electrostatic Potential Indicator.

For some time past there has been a great call for an instrument which would enable users of h.p. current to tell at a glance whether a circuit or apparatus is "alive." By the introduction of the potential indicator illustrated in fig. 2,

satisfactory results have been attained in this respect without absorbing any energy.

The principle embodied in this instrument is, that the fall of potential along a tube of insulating material has, generally speaking, an even gradient, that is to say, if 50,000-V is applied to the ends of a tube 50 cm. long, the fall of potential will be at the rate of 1,000-V per cm. of length. If a metal pivot is inserted in the centre of the length of the tube and at right angles to its axis, the difference of potential between this and either end will then be 25,000-V. Again, if this pivot has a metal needle of about 10 cm. length mounted on it, with a slight bias towards one side, then there will be an electrostatic attraction between each end of the needle and the axis of the tube, due to the difference of potential of 5,000 volts, tending to turn it parallel to the axis of the tube. In the practical instrument based on the above principle, a tube of special dark-coloured insulating material is supplied which has a broad white line along its outer side with a considerable gap in the centre of its length. At the centre of the interrupted line is a bridge carrying a freely moving but slightly biased pivoted white aluminium strip, and a pointer, coloured red, fixed at a small angle to the axis of the tube. Midway along the tube is fixed a concentric glass cylinder, supported between metal cheeks, which encloses the aluminium strip. Terminals are provided at the ends of the tube for the connecting leads. If desired, however, a flange can be fitted at the lower end so that the instrument can be fixed in a vertical position or a hook can be fitted at the upper end so that the apparatus can be hung on a high potential conductor. The length of the tube varies in accordance with the maximum potential of the circuit, and the indicator is made in six standard sizes, covering a range up to 80,000-V.

When in use one end of the tube must be connected to the high potential line and the other to "earth," and if the pressure is above minimum for registration on the particular instrument, the aluminium pointer will turn towards the axis of the tube, its position relative to the fixed pointer being clearly visible. When the maximum pressure has been applied, the needle remains statically charged for some time after the circuit pressure has been removed. This is similar to the effect noticeable on high potential overhead and underground cables, which, if isolated at both ends, retain their charge for a certain period, a phenomenon which the potential indicator indicates, and thus prevents the accidental and dangerous discharge of such conductors by personal contact.

The Liberty Wander Plug.

A large proportion of the radio valves that come to an untimely end are destroyed by the accidental connection of the h.p. battery across the filament. The RADIO-ARC ELECTRICAL CO., LTD., of 1, Warwick Street, London, W.1, claims that this loss can be avoided by the use of the "Liberty" wander plug for h.p. connections. It contains a resistance material

Fig. 3—The Liberty Wander Plug.

having, in the case of bright valves, a value of about 500 ohms, and when in use the plug (fig. 3) will supply sufficient h.p. current for the needs of the circuit, but will not permit enough to pass to destroy the valve filament. It will also protect the battery from excessive demands should the two leads be accidentally brought into contact and at the same time tends to diminish "frizzling" in the headphones and loud speaker.

Legal.

British Thomson-Houston Appeal.

THE appeal of the British Thomson-Houston Co., Ltd., in the case between itself and British Insulated and Helsby Cables, Ltd., now appears in the list of cases set down for hearing in the House of Lords, though it may possibly not be taken for some time yet, as several causes stand before it in that list.

Loud Speakers: Price Cutting.

WITH reference to the case of Sterling Telephone and Electric Co., Ltd., *v.* the T.S.M. Co., of which only brief mention was made in our issue of October 10th (p. 558), we learn from the plaintiffs that the Order of the Court was that the defendants, the T.S.M. Co., its servants, and agents be restrained from infringing the plaintiffs' letters patent No. 207,898 of 1922, granted in respect of "Improvements in the construction of telephone receivers," by selling Sterling "baby" loud speakers below the retail prices therefor from time to time fixed by the plaintiffs, and from otherwise or in any manner infringing the plaintiffs' said letters patent. The defendants were ordered to pay to the plaintiffs their costs of the action, to be taxed by the Taxing Master in case the parties differed.

We are also informed that in the Chancery Division (Mr. Justice Romer), on October 8th, in the case, Sterling Telephone and Electric Co., Ltd., and M. R. Lawrence *v.* Bearman Bros., an Order was made restraining the defendants from infringing the same patent by selling Sterling "Dinkie" loud speakers below the retail prices therefor from time to time fixed by the plaintiffs, and from otherwise or in any manner infringing the plaintiffs' said letters patent. The defendants were ordered to pay to the plaintiffs £7 7s., their agreed costs of the action.

Sterling Telephone and Electric Co., Ltd., v. Camden Stores.

IN the Chancery Division on November 7th, Mr. Justice P. O. Lawrence had this case before him.

Mr. MORITZ said it was one of that class of case where there had been the sale of a patented article under an agreed price. His learned friend appearing for the defendants had raised some very interesting points of law which could not be discussed on a motion. It had been agreed that there should be no order on the motion except that costs be costs in the cause and the defendants would undertake to keep an account meanwhile.

His Lordship assented to this.

Southport Corporation v. Birkdale District Electric Supply Co., Ltd.

IN the Chancery Division on November 6th, Mr. Justice Astbury commenced the hearing of an action brought by the Southport Corporation against the Birkdale District Electric Supply Co., Ltd., for an injunction restraining the defendant company from charging the Corporation or any other private consumer of electrical energy any price exceeding the price for the time being charged by the Corporation for a similar supply within the area which, on December 31st, 1901, constituted the borough of Southport, or from otherwise committing a breach of the provision contained in Clause 4 of a Supplemental Indenture dated December 31st, 1901, made between the Birkdale Urban District Council and the defendant company. Sir John Simon, K.C., and Mr. Bischoff appeared for the plaintiffs, and Mr. Clauson, K.C., and Mr. Guest Mathews for the defendants.

In opening plaintiffs' case, Sir JOHN SIMON stated that the defendant company was created for the express purpose of carrying out an arrangement which was made, and the action was brought by the Corporation, which was the successor of the Birkdale Urban District Council, for an order to enforce obedience of the terms of a contract by which the defendant company had bound itself. Southport had taken in both Birkdale and Ainsdale, but at the time of the contract the Birkdale or Ainsdale area was not included in Southport. At the time when these matters arose in the old borough of Southport, electrical energy was supplied by the Corporation under statutory powers. Birkdale was supplied under the Birkdale Electric Supply Order, which had been transferred to the company on the condition that it would not charge the consumers in its area a price higher than that prevailing at the time in Southport. The company suggested that it could not be held to its contract because the terms of the Order fixed maximum prices higher than those which the contract permitted. Counsel thought the case would turn on the terms of Clause 4 of the Supplemental Agreement of December 31st, 1901, which were: "Subject to any order made by the Board of Trade, the prices to be charged by the defendant company to private consumers of electrical energy should be for any quantity up to 20 units in any one quarter, 13s. 4d.; for any quantity not exceeding the equivalent of 100 hours of supply at the maximum demand in any quarter at the price of 7d. per unit, and for any further quantity in such quarter in excess of the equivalent of 100 hours of supply at such maximum, at the rate of 2d. per unit. But if in any year the prices of electrical energy supplied should exceed the prices of electrical energy supplied in the adjoining borough of Southport (as the same then existed), the beforementioned prices should be reduced, and for so long as might be necessary in order that the said prices might not exceed the prices in the borough of Southport." The main question, added counsel, was whether this was an effective and binding stipulation. If it was, plaintiffs were in the right. In their defence, the defendants said it was an implied term or condition of the indenture that the clause as to reduction of price should operate only if and so long as the Southport Corporation should carry on its undertaking on the lines of a commercial business undertaking, which should pay its way and be self-supporting, and accordingly that the price of electrical energy in the area should be a price with which the defendants could compete on fair terms, and at any rate should not preclude the defendants from carrying on business as a trading concern at a reasonable profit. They also said that the clause was so wide, unreasonable, and improvident as to be *ultra vires*. They said it was contrary to public policy that the defendants should by contract render them-

selves unable to carry out their obligations under the Order, and they would be unable to do so if they were limited to the prices charged for electrical energy by the Corporation.

The hearing was resumed on November 7th, when Mr. Collins was cross-examined by Mr. CLAUSON. He said that to reduce the company's rate to the Southport rate would mean a reduction of income by £5,000. Counsel pointed out that £3,000 was all that was required to pay the dividend, that £5,000 was carried to reserve, and that £7,000 had been carried forward.

In reply to his LORDSHIP, Mr. COLLINS said if the company's rate were reduced to the level of the Southport rate, the company's undertaking would still be a prosperous business.

Mr. A. HOBSON, borough treasurer of Southport, said the suggestion that in no case had the company charged the Corporation more than the Southport rate was not correct. The account for the last June quarter showed that the company charged for lighting energy supplied to the Consumption Hospital owned by the Corporation 8d., 7½d., and 6d. There was no agreement between the Corporation and the company which enabled the latter to charge those rates.

Mr. CLAUSON, who did not call any witnesses for the defendants, said the answer to the allegation that they had broken their contract was that it was not the company's contract. Although it might have signed something which was relied on as a contract, it could not in law divest itself of its statutory powers and duties. He therefore asked that the action should be dismissed.

Sir JOHN SIMON, in reply, said it was not inconsistent or incompatible with the purpose for which the company was created or with the exercise of its powers that it should enter into the contract in question.

His LORDSHIP reserved judgment, and said he would probably deliver it on November 11th.

Atherton (H.M. Inspector of Taxes) v. British Insulated and Helsby Cables, Ltd.

IN the Court of Appeal, before the Master of the Rolls and Lords Justices Warrington and Scrutton, on November 6th and 7th, this case was heard upon the appeal of the Inspector of Taxes from the judgment of Mr. Justice Rowlatt, affirming a decision of the Income Tax Commissioners.

The question on which the opinion of the Court was sought was whether a contribution of £31,784 made by the respondent company to a pension fund established for the benefit of its clerical and technical salaried staff could be deducted in computing the profits for the purpose of assessment to income tax for the year ended April 5th, 1918.

The appellant (the Crown) contended that the payment of the said sum was not an expenditure in carrying on the business and insofar as it was expenditure in connection with that business was expenditure for a capital purpose. The case was reported in our issue of July 4th (p. 44). Before 1916 the company had not paid pensions to employés who retired on account of old age, and it was alleged that its business suffered accordingly. A pension fund was constituted by a trust deed dated August 8th, 1916. Each member who elected to join the fund undertook to contribute 5 per cent. of his salary to it and anyone over the age of 40 who joined the staff after the beginning of the fund paid a higher rate. The company contributed an amount equivalent to one-half of the contributions of the members, in addition to contributing £31,784 as the nucleus of the fund.

The benefits provided were (1) in the event of retirement at the age of 65 and in certain other circumstances a pension depending on the length of service; and (2) in other cases a return of the member's contribution with interest. The contention of the company was that the sum in question was irrevocably parted with and was not represented by any asset of the company and therefore that the sum should be allowed as a deduction in computing the company's profit for the purpose of income tax. The contention on behalf of the Crown, however, was that the sum was not money exclusively laid out for the purposes of the trade and was in the circumstances capital withdrawn from the trade and therefore not deductible from profits under the material Rules of Schedule D.

Sir Patrick Hastings, K.C., and Mr. R. P. Hills appeared for the Crown; and Mr. A. M. Latter, K.C., and Mr. Hildersley represented the respondent company.

At the conclusion of the arguments, their LORDSHIPS held upon the facts as found by the Commissioners that the sum of £31,784 was not a payment properly deducted from income for the purpose of computing the profits of the company for the purpose of assessment to income tax. They thought that Mr. Justice Rowlatt was wrong in thinking that he was bound by a precedent and should have reversed the decision of the Commissioners. The appeal of the Crown was accordingly allowed.

Factory Act Prosecution.

AT Manchester County Police Court, on November 6th, the New Failsworth Hat Company, Ltd., was fined £2 2s. in each of two cases for breaches of the Factory Act, involving the death of an employé from electric shock. On behalf of the defendants Mr. Low said the regulations were so technical that the firm left those matters in the hands of an employé whom they regarded as a competent workman. They were ignorant of the breach of regulations.

Published Specifications.

Compiled expressly for this journal by Patent Agents.
The name of the applicant's patent agent, if any, will be found on the printed specification.
The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1923.

9,735. "Head-piece telephones." L. Dunwoodie. April 10th, 1923. (223,043.)

10,373. "Switching for multi-circuit radio receivers." L. E. Taylor, E. A. Taylor, W. Parkinson, and R. S. Bunting. April 17th, 1923. (223,258.)

14,652. "Wireless receiving systems." Soc. Francaise Radio-Electrique and H. J. J. M. de R. de Bellesciae. June 4th, 1923. (223,267.)

15,048. "Mine signal-recording apparatus." J. R. C. August and E. K. Hunter. June 8th, 1923. (223,270.)

15,885. "Electric relays." A. H. Railing, A. E. Angold, and W. Wilson. June 19th, 1923. (223,274.)

16,014. "Thermionic valves." C. S. Franklin. June 20th, 1923. (223,276.)

16,170. "Automatic electric regulators." British Thomson-Houston Co., Ltd., H. Trencham, and R. D. Parry. June 21st, 1923. (223,281.)

16,450. "Thermionic-valve holder." W. E. H. Humphreys. June 25th, 1923. (223,337.)

18,115. "Coil junction casings for electric cables." Felten & Guilleaume Carlswerk Akt. Ges. July 12th, 1922. (200,830.)

18,248. "Electromagnetic mechanisms." Automatic Telephone Manufacturing Co., Ltd., and A. E. Hudd. July 14th, 1923. (223,289.)

18,251. "Electric conduit fittings." F. Firth. July 14th, 1923. (223,290.)

18,332. "Vacuum electric tubes." E. Y. Robinson. July 16th, 1923. (Cognate application 958/24.) (223,293.)

18,348. "Heating-units for electric heaters." A. Nielsen. July 16th, 1923. (223,294.)

18,468. "Thermionic discharge tubes." British Thomson-Houston Co., Ltd. (General Electric Co.). July 17th, 1923. (223,304.)

18,512. "Thermionic valves and the like." H. J. Osborn and W. L. Turner. July 18th, 1923. (223,306.)

18,519. "Method of adding capacities to telephone circuits." Western Electric Co., Ltd. (Western Electric Co. Inc.). July 18th, 1923. (223,307.)

18,580. "Electrodes having a high-electron emissivity and method of making them." British Thomson-Houston Co., Ltd. August 3rd, 1922. (201,900.)

18,913. "Reception of wireless telegraphy or telephony without an aerial." M. Richardson. July 23rd, 1923. (223,321.)

19,357. "Induction motors." W. A. Benger and F. & A. Parkinson, Ltd. July 28th, 1923. (223,332.)

19,411. "Tubing in connection with electric lighting and other purposes." J. N. Hewitt. July 28th, 1923. (223,334.)

19,586. "Unloaded telephone circuits or the like." General Electric Co., Ltd., and A. C. Bartlett. July 31st, 1923. (223,336.)

19,778. "Terminal fittings for electric apparatus." Walsall Hardware Manufacturing Co., Ltd., A. E. Read, and A. E. Millard. August 2nd, 1923. (223,340.)

19,898. "Electric control switches." Crompton & Co., Ltd., and W. F. Jones. August 3rd, 1923. (223,343.)

22,308. "Electromagnetic sound reproducers." Fullers United Electrical Works, Ltd., and A. P. Welch. September 4th, 1923. (223,363.)

22,655. "Apparatus for bending light electric conduit and other tubes." J. F. Carey. September 10th, 1923. (223,366.)

22,735. "Observing and recording changes in electric currents and in magnetic fields." G. Gmur et Cie. and G. Gmur. September 10th, 1923. (223,368.)

23,942. "Telephone receivers." E. S. Pridham. October 25th, 1922. (206,126.)

24,248. "Telephone systems." Coventry Automatic Telephones, Ltd., and C. W. Wilman. September 29th, 1923. (223,385.)

25,336. "Electric street advertisement kiosk." B. Faudel. October 11th, 1923. (223,396.)

25,732. "Impulse circuit arrangements for automatic switches or repeaters of the type used in telephone systems." Automatic Telephone Manufacturing Co., Ltd., and C. Gillings. October 15th, 1923. (Addition to 205,665.) (223,399.)

26,552. "Panels and units for electric installations and particularly wireless installations." C. S. Lambton and F. Nelson. October 24th, 1923. (223,402.)

27,270. "Carrier or means for supporting electric lamp or other shades, reflectors, and the like." A. P. Rutherford and A. N. Haddow. October 31st, 1923. (223,406.)

27,522. "Wall boxes for containing electric switches and the like." E. T. Davies and Wandsworth Electrical Manufacturing Co., Ltd. November 2nd, 1923. (223,411.)

28,358. "Dynamo-electric machines." English Electric Co., Ltd., J. E. Calverley, and W. E. Highfield. November 10th, 1923. (223,416.)

29,165. "Vapour-generators for liquids having a relatively high boiling-point, such as mercury." British Thomson-Houston Co., Ltd. (General Electric Co.). November 23rd, 1923. (223,426.)

30,866. "Induction electricity meter." C. E. J. Brandt, E. A. Fouillaret, and R. M. Fichter. March 20th, 1923. (213,221.)

31,768. "Telephones." Siemens & Halske Akt. Ges. May 19th, 1923. (216,092.)

1924.

2,036. "Electric riveter." C. J. Walker. January 25th, 1924. (223,459.)

2,099. "Electric current-limiting arrangement." K. Kambayashi. January 25th, 1924. (223,460.)

2,857. "Electric furnace for welding, tempering, burning, or for heating for other purposes." C. E. Cornelius. February 15th, 1923. (211,402.)

3,340. "Electric connecting devices operating as circuit changing switches." H. T. Brooker and L. E. Williams. February 8th, 1924. (223,463.)

4,393. "Protective arrangements for electric circuits." British Thomson-Houston Co., Ltd. (General Electric Co.). February 20th, 1924. (223,477.)

5,175. "Device for measuring the wattless load or wattless energy in single or polyphase alternating current circuits." Landis & Gyr Soc. Anon. March 14th, 1923. (212,892.)

5,444. "Variable control devices for electrical apparatus, such as condensers, variometers, and the like." Pacent Electric Co. Inc. April 6th, 1923. (213,892.)

5,936. "Accumulator plate supporting devices." W. Haddon, J. M. Burnett, and J. A. Fullilove. March 7th, 1924. (223,487.)

10,708. "Induction motors." Dr T. Torda. February 6th, 1924. (223,500.)

11,121. "Electric cables." British Insulated & Helsby Cables, Ltd., J. L. Packer, and C. Vernier. August 3rd, 1923. (Divided application on 19,578/23.) (223,511.)

12,404. "Bonding clamps and junction boxes for metal-sheathed electric wires and cables." W. T. Henley's Telegraph Works Co., Ltd., and W. R. Clements. May 20th, 1924. (223,516.)

12,993. "Torches for sealing-off electric lamp bulbs and the like." British Thomson-Houston Co., Ltd. June 4th, 1923. (217,207.)